PACIFIC SALMON COMMISSION
JOINT CHUM TECHNICAL COMMITTEE

2010 POST SEASON SUMMARY REPORT

TCCHUM (13)-1

February 2013

MEMBERSHIP OF THE PSC JOINT CHUM TECHNICAL COMMITTEE, 2010

Canadian Members	United States Members
Mr. Pieter Van Will, Co-Chair, CDFO	Mr. Kit Rawson, Co-Chair, Tulalip Tribes
Ms. Kim Charlie, Chehalis Indian Band	Ms. Rebecca Bernard, Upper Skagit Indian Tribe
Mr. Leroy Hop Wo, CDFO	Mr. Wayne Haight, PNPTC
Ms. Marla Maxwell, CDFO	Ms. Amy Seiders, NWIFC
Mr. Joe Tadey, CDFO	Dr. Gary Winans, NOAA

MEMBERSHIP OF THE PSC JOINT CHUM TECHNICAL COMMITTEE, 2011

Canadian Members	United States Members
Mr. Pieter Van Will, Co-Chair, CDFO	Mr. Kit Rawson, Co-Chair, Tulalip Tribes
Ms. Kim Charlie, Chehalis Indian Band	Ms. Rebecca Bernard, Upper Skagit Indian Tribe
Mr. Leroy Hop Wo, CDFO	Ms. Amy Seiders, NWIFC
Mr. Jason Mahoney, CDFO	Dr. Maureen Small, WDFW
Mr. Joe Tadey, CDFO	Dr. Gary Winans, NOAA

MEMBERSHIP OF THE PSC JOINT CHUM TECHNICAL COMMITTEE, 2012

Canadian Members	United States Members
Mr. Pieter Van Will, Co-Chair, CDFO	Mr. Kit Rawson, Co-Chair, Tulalip Tribes
Mr. John Candy, CDFO	Ms. Rebecca Bernard, Upper Skagit Indian Tribe
Ms. Kim Charlie, Sts'ailes; formerly known as Chehalis Indian Band	Ms. Amy Seiders, NWIFC
Ms. Marla Maxwell, CDFO	Dr. Maureen Small, WDFW
Mr. Joe Tadey, CDFO	Dr. Gary Winans, NOAA

LIST OF ACRONYMS WITH DEFINITIONS

B.C.	British Columbia
CDFO	Canadian Department of Fisheries and Oceans or Fisheries and Oceans Canada
CPUE	Catch per Unit Effort
CU	Conservation Unit (Canada)
CWT	Coded-Wire Tag
ECVI	East Coast Vancouver Island
EO	Economic Opportunity
ESSR	Excess Salmon to Spawning Requirements
ESU	Evolutionarily Significant Unit
FN	First Nation
FN FSC	First Nations Food, Social and Ceremonial
FSC	Food, Social, and Ceremonial (Canada)
GN	Gill net
GSI	Genetic Stock Identification
ITQ	Individual Transferable Quota
mtDNA	Mitochondrial DNA
mSAT	Microsatellite DNA
NOAA	National Oceanic and Atmospheric Administration
PFMA	Pacific Fishery Management Area
PSC	Pacific Salmon Commission
PST	Pacific Salmon Treaty
SJF	Strait of Juan de Fuca
SJI/PR	San Juan Islands/Point Roberts
SN	Seine net
SNPs	Single-Nucleotide Polymorphisms
TCCHUM	Chum Technical Committee
TR	Troll
U.S.	United States of America
WA	Washington State
WCVI	West Coast Vancouver Island
WDFW	Washington Department of Fish and Wildlife
WSP	Wild Salmon Policy (Canada's Policy for Conservation of Wild Pacific Salmon)

TABLE OF CONTENTS

MEMBERSHIP OF THE PSC JOINT CHUM TECHNICAL COMMITTEE, 2010 ii
MEMBERSHIP OF THE PSC JOINT CHUM TECHNICAL COMMITTEE, 2011 ii
MEMBERSHIP OF THE PSC JOINT CHUM TECHNICAL COMMITTEE, 2012 ii
LIST OF ACRONYMS WITH DEFINITIONS iii
TABLE OF CONTENTS iv
LIST OF TABLES vi
LIST OF APPENDICES vii
1 EXECUTIVE SUMMARY 1
2 STATUS OF TREATY REQUIREMENTS 1
3 SOUTHERN BRITISH COLUMBIA CHUM SALMON 6
3.1 Introduction 6
3.2 Status of Treaty Requirements 6
3.3 Conservation and Harvest Management Strategies 6
3.3.1 Johnstone Strait Chum Salmon Management Strategy 6
3.3.2 Strait of Georgia Chum Salmon Management Strategy 8
3.3.2.1 Area 14 Chum Salmon Management Strategy 10
3.3.2.2 Area 16 Chum Salmon Management Strategy 12
3.3.2.3 Area 17 Chum Salmon Management Strategy 13
3.3.2.4 Area 18 Chum Salmon Management Strategy 14
3.3.2.5 Area 19 Chum Salmon Management Strategy 16
3.3.3 Fraser River Chum Salmon Management Strategy 17
3.3.3.1 Fraser River In-season Terminal Abundance Estimation 18
3.3.4 West Coast Vancouver Island Chum Salmon Management Strategy 19
3.3.4.1 Nitinat Chum Salmon Management Strategy 20
3.4 Annual Fishery Descriptions 21
3.4.1 Johnstone Strait 22
3.4.2 Strait of Georgia 23
3.4.3 Fraser River 24
3.4.4 West Coast Vancouver Island 29

3.4.4.1 Nitinat 29
3.5 Escapement 30
3.5.1 Inside Southern 30
3.5.2 West Coast Vancouver Island 31
4 UNITED STATES CHUM SALMON 33
4.1 Washington Run Sizes, Catches, and Spawning Escapements 33
4.2 United States Strait of Juan de Fuca Fisheries (Areas 4B, 5, 6C) 36
4.2.1 Management Intent 36
4.2.2 Fishery Description 36
4.3 San Juan Islands / Point Roberts Fisheries (Areas 7 and 7A) 36
4.3.1 Management Intent 36
4.3.2 Fishery Description 37
5 STOCK IDENTIFICATION 38
5.1 Tagging of Adult Chum Salmon 38
5.2 Otolith, Fin Marking and Coded Wire Tagging (CWT) 38
5.2.1 Canada 38
5.2.2 United States 40
5.3 Genetic Stock Identification 41
5.3.1 Fishery Sample Collection for Genetic Stock Identification 41
5.3.1.1 Canada 41
5.3.1.2 United States 42
5.3.2 Baseline Collection for Genetic Stock Identification. 43
5.3.2.2 Canada 43
5.3.2.1 United States 44
REFERENCES CITED 46
APPENDICES 47

LIST OF TABLES

Table 3-1. Assessment of the Clockwork (stepped harvest rate) and the current (fixed harvest rate) Johnstone Strait Chum Salmon Management Strategy, 2001–2010 [1] 7

Table 3-2. Current spawning escapement goal, hatchery requirements and overall escapement goal for Chum salmon returning to the Strait of Georgia by PFMA's and system. 9

Table 3-3. Key decision points for Fraser River Chum salmon management. 18

Table 3-4. Estimated harvest of summer Chum salmon by PFMA for commercial, research and test fishing vessels [1] (July through the second week of September), 2001–2010. 22

Table 3-5. Estimated Chum salmon harvest from Chum salmon-directed fisheries occurring in Johnstone Strait by PFMA, 2010. 23

Table 3-6. Estimated Chum salmon harvest from Chum salmon-directed fisheries occurring in the Strait of Georgia by PFMA, 2010. 24

Table 3-7. Estimated harvest of Chum salmon from salmon fisheries occurring in Area 29 (both marine and in-river) and in Region 2 (non-tidal) of the Fraser River, 2010. 25

Table 3-8. Estimated harvest of Chum salmon from First Nations and commercial salmon fisheries occurring in Area 29 and in Region 2 of the Fraser River, 2001–2010. 26

Table 3-9. Estimated harvest of Chum salmon in assessed (i.e. surveyed) lower Fraser River recreational fisheries, 2001–2010. 28

Table 3-10. Nitinat area harvest, hatchery broodstock collection and spawning escapement estimates by PFMA, 2001–2010. 30

Table 3-11. Inside Southern Chum salmon net escapement estimates (spawning escapement plus hatchery broodstock) for Fraser and Non-Fraser stock aggregates, 2001–2010 [1] 31

Table 3-12. WCVI Chum salmon spawning escapement estimates [1] by PFMA, 2001–2010. 32

Table 4-1. Puget Sound summer Chum salmon pre-season and post-season estimates of run size and estimated spawning escapements, 2001–2010. 33

Table 4-2. Washington fall Chum salmon pre-and post-season estimates of run size and estimated spawning escapements, 2001–2010. 34

Table 4-3. Washington winter Chum salmon pre- and post-season estimates of run size and estimated spawning escapements, 2001–2010. 34

Table 4-4. Harvest of Chum salmon in the Strait of Juan de Fuca and the San Juan Islands' commercial fisheries during the summer Chum salmon accounting period, July 1–September 15, 2001–2010. 35

Table 4-5. Harvest of summer, fall, and winter Chum salmon in SJF, SJI/PR, Puget Sound and Washington coastal areas, 2001–2010 [1]. 35

Table 5-1. Releases of Chum salmon with thermally-marked otoliths from WCVI based Canadian hatchery facilities, 2001–2010. 38

Table 5-2. Releases of marked Chum salmon from southern B.C. based Canadian hatchery facilities, 2001–2010 39

Table 5-3. Releases of CWT (coded-wire tag) Chum salmon and the associated unclipped releases, from southern B.C. based Canadian hatchery facilities, 2001–2010... 40

Table 5-4. Numbers of Hood Canal summer Chum salmon released with thermally-marked otoliths or an adipose fin clip by brood year, 2002–2010. 40

Table 5-5. Numbers of Puget Sound and Lower Columbia River fall Chum salmon released with thermally-marked otoliths or an adipose fin clip by brood year, 2002–2010. 41

Table 5-6. Chum salmon tissue samples collected in Johnstone Strait fisheries and analyzed for GSI, 2001–2010. 42

Table 5-7. Fall Chum salmon GSI tissue collections from Southern B.C. by Conservation Unit, collection site, life stage, and influence [1] of enhancement, 2010. 43

Table 5-8. Summer, fall and winter Chum salmon GSI tissue collections from WA State, 2010. 45

LIST OF APPENDICES

Appendix A. Annex IV, Chapter 6, of the Pacific Salmon Treaty 48

Appendix B-1. United States commercial salmon catch areas for the Strait of Juan de Fuca and Northern Puget Sound 51

Appendix B-2. Canadian Pacific Fishery Management Areas (PFMA) for Southern B.C. - Marine areas. 52

Appendix B-3. Canadian Pacific Fishery Management Areas (PFMA) for Southern B.C. - Lower Fraser River and surrounding areas. 53

Appendix C. Joint direction paper presented to the PSC Southern Panel concerning the development of Chum salmon stock identification methodologies. 54

Appendix D. PSC Work Plan for the Joint Chum Technical Committee, 2010–2011. 58

1 EXECUTIVE SUMMARY

This Pacific Salmon Commission (PSC) Joint Chum Technical Committee report presents the information on Chum salmon stocks and fisheries in southern British Columbia and Washington for the year 2010 to address the specific provisions and requirements of Chapter 6, Annex IV of the Pacific Salmon Treaty (PST or Treaty) (Appendix A). This was the second year of implementation for the version of Annex IV that was adopted January 2009.

The treaty between the governments of Canada and the United States of America (U.S.) concerning Pacific salmon is designed to facilitate co-operation between the two countries in the management, research and enhancement of Pacific salmon stocks. Chapter 6 of Annex IV (Chum Annex) of the PST requires that Canada and the U.S. maintain a Joint Chum Technical Committee reporting, unless otherwise agreed, to the Southern Panel and the Commission and that certain fisheries for Chum salmon in southern British Columbia (B.C.) and Washington be managed in a specified manner (Appendix A). Certain fisheries of each country, while not specifically mentioned in the PST, are known to harvest Chum salmon originating in the other country. This report presents various aspects of Chum salmon found in Washington State, in B.C. waters between Vancouver Island and the mainland, and off the west coast of Vancouver Island. This report also discusses the management actions of Canada and the U.S. in relation to the PST requirements for Chum salmon and provides a précis of the last 10 years of catch and escapement information for Chum salmon of concern to the Treaty.

2 STATUS OF TREATY REQUIREMENTS

Chum salmon stocks and fisheries in southern B.C. and in U.S. Areas 4B, 5, 6C, 7, and 7A (Appendix B) were managed under the terms set out in Chapter 6, Annex IV (Appendix A). The following provides a brief synopsis of the Canadian and U.S. management actions taken to meet its provisions in 2010.

Paragraph 1:

> *The Parties were to maintain a Joint Chum Technical Committee ("*the Committee"*) reporting, unless otherwise agreed, to the Southern Panel and the Commission. [Specific tasks for the Committee are listed in Annex IV Chapter 6, Paragraph 1. Some of these include review stock status, develop new methods for stock management and report on management and research findings.]*

The Committee convened three times in 2010: during the PSC Post-Season Meeting in January, during the PSC 25th Annual Meeting in February, and for additional work in La Conner, Washington, in May. In January of 2010, the Committee completed and presented to the PSC Southern Panel a joint direction paper concerning the development of Chum salmon stock identification methodologies (Appendix C). The Committee also published the *2007* and *2008 Post Season Summary Reports* in January and June of 2010, respectively, and continued development of proposals pertinent to Chum salmon genetic stock identification for submission to the PST Southern Boundary Restoration and Enhancement Fund (Southern Fund). Additional

detail of the work performed by the Committee in 2010 can be found in the Committee's 2010-2011 Work Plan (Appendix D).

Paragraph 2:

> *When the Parties provide stock composition information for fisheries, the Committee shall evaluate and report its conclusions using bilaterally agreed upon methods.*

For this report, the Committee continued to use historical stock composition information to estimate Chum salmon stock composition for 2010 fisheries. These historical stock composition estimates may no longer be representative of current stock composition, and the Committee is continuing to evaluate and implement new methods (Appendix C).

Paragraph 3:

> *Canada and the United States shall assess catch levels and make attempts to collect additional genetic samples from any Chum salmon caught during the July 1 through September 15 time period in the boundary area fisheries (U.S. Areas 4B, 5, 6C, 7 and 7A; Canadian Areas 18, 19, 20, 21, and 29).*

Table 3-4 and Table 4-4 provide the harvest of Chum salmon during the period of summer Chum salmon migration in boundary areas. Due to the low numbers of Chum salmon encountered, neither party collected samples for genetic stock identification (GSI) during this time period.

Paragraph 4:

> *During the period from July 1 through September 15, Canada will require the live release of Chum salmon from all purse seine gear fishing in the Strait of Juan de Fuca (Canadian Area 20) and the United States will require the same for the non-Indian seine fisheries in Areas 7 and 7A. Note: By U.S. regulation, purse seine fisheries are not permitted in U.S. Areas 4B, 5 and 6C.*

Regulations were implemented by both countries to require the live release of Chum salmon in these areas during this time period.

Paragraph 5:

> *Canada will manage its Johnstone Strait, Strait of Georgia, and Fraser River Chum salmon fisheries to provide continued rebuilding of depressed naturally spawning Chum salmon stocks, and, to the extent practicable, not increase interceptions of U.S. origin Chum salmon. Terminal fisheries conducted on specific stocks with identified surpluses will be managed to minimize interception of non-targeted stocks.*

Table 3-1 provides an evaluation of the performance of the Clockwork (2001) and the current Johnstone Strait management strategy (2002–2010). Historical GSI results and genetic estimates from 2006 through 2010 continued to indicate a low contribution of U.S. stocks in Johnstone Strait, Strait of Georgia and Fraser River Chum salmon fisheries.

In January of 2010, the Committee presented a joint direction paper to the Southern Panel (Appendix C), concerning the development of Chum salmon stock identification methodologies to be used for immediate and future stock assessment applications. Further work on this initiative has resulted in the development of the Committee's Strategic Plan, of which improved

stock identification methodologies play a significant role. The initial stages of this Strategic Plan have been implemented and work on the development and implementation of the final stage of the plan is ongoing.

Management strategies (see section 3.3) and annual fishery descriptions (see section 3.4) indicate that Canada's Johnstone Strait, Strait of Georgia, and Fraser River Chum salmon fisheries in addition to the terminal area fisheries, were managed to meet the provisions of Paragraph 5 of Annex IV, Chapter 6, of the PST.

Paragraph 6:

Canada will manage its Johnstone Strait mixed stock fishery as follows:

a) Inside Southern Chum salmon levels of less than 1.0 million as estimated by Canada are defined, for purposes of this chapter, as critical.

b) For run sizes above the critical threshold, Canada will conduct fisheries with an exploitation rate of up to 20% in Johnstone Strait of Inside Southern Chum salmon; and

c) When run sizes are expected to be below the critical threshold, Canada will notify the United States and will only conduct assessment fisheries and non-commercial fisheries. Commercial fisheries targeting Chum salmon will be suspended.

While no specific estimates of Inside Southern Chum salmon abundance were provided, Canada notified the U.S. on October 7, 2010, on the basis of inside area fisheries, the return abundance of Inside Southern Chum salmon was below the critical threshold. Canada suspended all planned commercial fisheries effective midnight October 8, 2010.

Paragraph 7:

Canada will manage its Fraser River fisheries for Chum salmon as follows:

a) For Fraser River terminal area run sizes, identified in-season, at abundance levels lower than 900,000 Chum salmon, the Canadian commercial Chum salmon fisheries within the Fraser River and in associated marine areas (Area 29), will be suspended; and

b) For Fraser River terminal area run sizes, identified in-season at levels greater than 900,000 Chum salmon, Canadian commercial Chum salmon fisheries within the Fraser River, shall be guided by the limits of the in-river Total Allowable Catch set by Canada.

In 2010, in-season estimates indicated a terminal return lower than the specified Fraser River gross escapement threshold (see section 3.4.3). No commercial fisheries were conducted as per the Fraser River management rules (see section 3.3.3).

Paragraph 8:

Canada will manage the Nitinat gill net and purse seine fisheries for Chum salmon to minimize the harvest of non-targeted stocks.

In 2010, in-season assessment information indicated the Nitinat return was insufficient to initiate commercial fisheries. As a result, commercial gill net and purse seine fisheries in Area 21 did not occur in 2010 (see section 3.4.4.1; Table 3-10).

Paragraph 9:

Canada shall conduct a genetic sampling program of Chum salmon taken in the West Coast Vancouver Island troll fishery if early-season catch information indicates that catch totals for the July 1 through September 15 season may reach levels similar to 1985 and 1986. Sampling, should it occur, will include catches taken from the southern areas (Canadian Areas 121–124).

Chum salmon catch levels in the 2010 West Coast Vancouver Island troll fishery were significantly below the 1985 and 1986 levels. Therefore, no GSI sampling occurred.

Paragraph 10:

The United States will manage its Chum salmon fishery in Areas 7 and 7A as follows:

a) Inside Southern Chum salmon levels of less than 1.0 million as estimated by Canada are defined, for purposes of this chapter, as critical;

b) For run sizes below the critical threshold, the U.S. catch of Chum salmon in Areas 7 and 7A shall be limited to Chum salmon taken incidentally to other species and in other minor fisheries, but shall not exceed 20,000, provided that catches for the purpose of genetic stock identification sampling shall not be included in the aforementioned limit;

c) For run sizes above the critical threshold, the base catch ceiling for the U.S. Chum salmon fisheries in Areas 7 and 7A will be 130,000 Chum salmon;

d) Canada will provide a run size estimate of Chum salmon entering the Fraser River no later than October 22. If the estimate is less than 900,000, the U.S. will limit its fishery impacts on Fraser River Chum salmon by restricting catch in Areas 7 and 7A to not exceed 20,000 additional Chum salmon from the day following the date the U.S is notified. The total catch is not to exceed the catch ceiling of 130,000 Chum salmon;

e) U.S. commercial fisheries for fall Chum salmon in Areas 7 and 7A will not occur prior to October 10;

f) The U.S. will manage the Areas 7 and 7A fisheries for Chum salmon with the intent to minimize the harvest of non-targeted species;

g) No U.S. catch shortfalls may be accrued; however any overages shall be carried forward as indicated in (h) and (i);

h) Due to management imprecision, a catch in the U.S. of up to 135,000 Chum salmon will not result in an overage calculation. Catches in excess of 135,000 Chum salmon shall result in an overage being calculated by subtracting 130,000 from the total Chum catch. Overages will be accounted for by reducing the U.S. annual catch ceiling in up to two subsequent non-critical Inside Southern Chum salmon years; and

i) From the day following the date the U.S. is notified of a run size below the critical threshold as defined in 10(b) or (d), any catches in excess of 20,000 Chum salmon will result in an overage. Overages will be accounted for by reducing the U.S. annual catch ceilings in up to two subsequent non-critical Inside Southern Chum salmon years.

In 2010, U.S. fisheries in Areas 7 and 7A were managed in accordance with the above provisions (see section 4.3). An initial in-season Fraser River Chum salmon terminal abundance estimate of 1.098 million was provided to the U.S. on October 15, 2010 allowing the U.S. to initiate commercial fishing. Commercial fisheries were opened on October 16, 2010 and ran continuously through October 22, 2010. An additional update of the estimated Fraser Chum salmon abundance was provided by Canada on October 18, with an estimate of 810,000, triggering the limit of 20,000 additional Chum salmon to be caught in Areas 7 and 7A beginning October 19, 2010.

Paragraph 11:

The United States shall conduct its Chum salmon fishery in the Strait of Juan de Fuca (United States Areas 4B, 5, and 6C) so as to maintain the limited effort nature of this fishery, and, to the extent practicable, not increase interceptions of Canadian origin Chum salmon. The United States shall continue to monitor this fishery to determine if recent catch levels indicate an increasing level of interception.

This fishery is restricted to Treaty Indian fishers from four tribes and to gill net gear only. The Committee has not specifically addressed interception estimates during the 1994 through 2010 time period. Genetic stock identification (GSI) samples collected from this fishery in prior years indicate the majority of the catch is Chum salmon of U.S. origin. The total catch and effort in this fishery has remained at historically low levels (see section 4.2; Table 4-5).

Paragraph 12:

All information concerning by-catch of other salmon species from the Chum salmon fisheries covered by this chapter will be shared between the Parties in the annual Post Season Report.

Bycatch of other salmon species from the Chum salmon fisheries covered by this chapter were reported in the 2010 annual post season reports of the Parties.

Paragraph 13:

Should circumstances arise that are inconsistent with either Parties understanding of the intent of the chapter, the Southern Panel will discuss the matter postseason and explore options for taking the appropriate corrective actions.

No such circumstances arose in 2010.

3 SOUTHERN BRITISH COLUMBIA CHUM SALMON

3.1 Introduction

Southern B.C. Chum salmon stocks and fishing areas (Pacific Fishery Management Areas or PFMAs; Appendix B) are, for the purposes of management, analysis and reporting, grouped into four major units: Johnstone Strait, Strait of Georgia, Fraser River, and the West Coast Vancouver Island (WCVI). Additionally, Chum salmon originating from Johnstone Strait, the Strait of Georgia, and the Fraser River are collectively described as Inside Southern Chum salmon.

3.2 Status of Treaty Requirements

During 2010, the Southern B.C. Chum salmon fisheries were managed according to the requirements of Annex IV, Chapter 6, as amended in 2009 (Appendix A).

3.3 Conservation and Harvest Management Strategies

The general management approach adopted by Fisheries and Oceans Canada (CDFO) for Southern B.C. Chum salmon is to achieve wild escapement targets, while augmenting production through enhancement of selected stocks. In practice, this approach is achieved through the application, in mixed stock fisheries, of harvest rates which are compatible with wild or natural stock productivity. If there are Chum salmon stocks that return to their area of origin in numbers above that area's escapement goal, they may be subject to additional harvesting within their terminal areas.

The following describes the management strategies and fishing plans for the four units of Southern B.C. Chum salmon stocks.

3.3.1 Johnstone Strait Chum Salmon Management Strategy

The Clockwork management strategy, in use from 1983 to 2001 in the Johnstone Strait Chum salmon fisheries occurring in PFMAs (or Areas) 12 & 13, was a stepped exploitation rate approach and is described in the 1985 Post-Season Summary Report of the PSC Joint Chum Technical Committee (CHUMTC 1987). The Clockwork strategy was designed to rebuild wild Inside Southern Chum salmon stocks to the estimated optimum escapement levels by limiting the overall harvest rate. Ryall *et al.* 1999 provided an assessment of the effectiveness of the Clockwork strategy. The Clockwork strategy required accurate estimates of catch and escapement and the reliability of this strategy depended upon the quality of these data. During the time period in which Inside Southern Chum salmon stocks were managed by the Clockwork strategy, the high variability in Chum salmon returns, the inadequate escapement coverage, and highly unstable fishing opportunities demonstrated a need to move to an alternative approach.

Table 3-1. Assessment of the Clockwork (stepped harvest rate) and the current (fixed harvest rate) Johnstone Strait Chum Salmon Management Strategy, 2001–2010 [1].

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
PRE-SEASON										
Inside Southern Abundance Forecast (or Outlook)	Below Average	Average to Above Average	Below Average	Average	Average	Average	Average to Above Average	Below Average	Below Average	Average to Below Average
IN-SEASON										
Management Strategy	Clockwork	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
POST-SEASON										
Inside Southern Abundance [2]	4,871,106	5,090,263	3,528,029	5,481,409	3,073,916	4,289,905	2,632,072	2,225,412	2,189,546	1,068,045
Inside Southern Harvest	760,881	1,600,839	1,298,112	1,838,443	1,251,536	1,515,578	788,025	577,518	744,653	127,280
Est. Inside Southern Harvest Rate	15.6%	31.5%	36.8%	33.5%	40.7%	35.3%	29.9%	26.0%	34.0%	11.9%
Johnstone Strait Harvest										
Commercial, Sport Areas 11-13 [3]	209,914	668,936	924,505	1,176,611	856,029	859,201	480,620	299,775	513,884	56,410
First Nations Areas 11-13	23,562	17,131	14,780	27,041	18,841	16,453	14,870	11,630	13,576	4,060
Johnstone Strait Harvest Total	233,476	686,067	939,285	1,203,652	874,870	875,654	495,490	311,405	527,460	60,470
Target Johnstone Strait Harvest Rate	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
Est. Johnstone Strait Harvest Rate	4.8%	13.5%	26.6%	22.0%	28.5%	20.4%	18.8%	14.0%	24.1%	5.7%
ESCAPEMENT (includes wild and enhanced) [4]										
Inside Southern Escapement	4,110,225	3,489,424	2,229,917	3,642,966	1,822,380	2,774,327	1,844,047	1,647,894	1,444,893	940,765

(1) Historic data in this table have been updated with most recent estimates; values may deviate from past reports.
(2) Total Inside Southern abundance includes total Inside Southern harvest plus escapement. Harvest composition based on historic GSI for all fisheries.
(3) Includes commercial, sport and test fishery harvest.
(4) Escapement estimates do not include any removals associated with hatchery rack (e.g. ESSR); those values are included in harvest. Escapement estimates have not been expanded for populations not monitored for escapement.

Following extensive technical reviews and several years of discussions with First Nations, stakeholders and the commercial fishing industry, the Clockwork's stepped exploitation rate approach was replaced in 2002 by a stable fishing schedule designed to approximate a fixed exploitation rate (~20%). Tagging studies conducted from 2000 through 2002 helped in the development of this fixed exploitation rate strategy by assessing the migration timing and harvest rate by fishing gear on an available abundance of Chum salmon in Johnstone Strait. This fixed exploitation strategy continued to be employed through 2010 (CDFO 2010).

Some of the key objectives of this strategy are to ensure sufficient escapement levels while providing more stable fishing opportunities (CDFO 2010). The exploitation rate is set at 20% across all harvesters, when abundance is estimated to be above a critical level. The critical level, or threshold, was determined to be 1.0 million Chum salmon (Appendix A). The Johnstone Strait Chum salmon test fishery, as well as the information gained from any commercial openings, is used in-season to determine the likelihood of achieving the critical level for Inside Southern Chum salmon. When expected levels are less than 1.0 million, only assessment fisheries and non-commercial fisheries will be conducted and any planned commercial fisheries targeting Chum salmon will be suspended (Appendix A). When the critical level is expected to be achieved, fisheries with an exploitation rate of up to 20% in Johnstone Strait can be conducted (Appendix A).

Of this 20%, the commercial sector is allocated 15%. The remaining 5% is set aside to provide for First Nations' food, social and ceremonial needs (FSC), satisfy recreational and test fishing requirements, and to provide a buffer to the commercial exploitation (CDFO 2010). The impact of the Johnstone Strait fisheries, Clockwork years (1998–2001) and the subsequent fixed exploitation approach (2002–2010), on Inside Southern Chum salmon stocks are detailed in Table 3-1.

The specific objectives of the fixed exploitation rate strategy are to:

- continue to rebuild/maintain stocks to the optimum wild escapement objective (defined as 2.5 million wild Inside Southern Chum salmon);
- establish a pre-season fishing plan to achieve an exploitation rate of 20% on Inside Southern Chum salmon in the Johnstone Strait Chum salmon fishery; and,
- stabilize commercial catch rates to provide opportunities at both low and high abundance levels.

3.3.2 Strait of Georgia Chum Salmon Management Strategy

Chum salmon stocks return to all areas of the Strait of Georgia (mid-Vancouver Island PFMA's 14-19) and are of enhanced and wild (natural) origin. Fisheries can target enhanced returns (e.g. Area 14: Puntledge, Qualicum and Little Qualicum rivers), wild returns (e.g. Area 16: main river systems of Tzoonie, Deserted and Skwawka Rivers in the Jervis inlet area) and mixed returns (e.g. Area 19: directed primarily at enhanced Goldstream River populations although some natural Cowichan River Chum salmon are also harvested).

With one exception, pre-season forecasts of the return of Strait of Georgia Chum salmon for population aggregates corresponding to PFMA's have limited use due to their inability to reasonably predict returns (CDFO 2010). The one exception is Chum salmon returning to Area 14. As a result, unlike some other units of Southern BC Chum Salmon (e.g. WCVI see section 3.3.4), pre-season fishing plans based on a pre-season forecast are not typically developed for Strait of Georgia Chum salmon stocks.

Strait of Georgia Chum salmon are managed as a component of a "mixed-stock harvest strategy" for Johnstone Strait and the northern Strait of Georgia. In-season management of Strait of Georgia Chum salmon is guided by advice from the South Coast Chum Advisory Committee (Chum Advisory Committee or Chum Working Group). The Chum Working Group represents interests for Strait of Georgia (mid-Vancouver Island Areas 14-19), Johnstone Strait, WCVI and Fraser River Chum salmon-directed fisheries. Fishing opportunities for Chum salmon are evaluated at weekly meetings of the Chum Working Group that usually start in the first week of October. In-season data is reviewed on a weekly basis until the conclusion of the fishing season that usually occurs around the end of November. The Chum Working Group includes internal (CDFO staff) and external (First Nations, commercial and recreational) representation and has been in operation since 2004. Additionally, Chum salmon management in Area 18 is also guided by advice from the Cowichan Fisheries Roundtable.

Chum salmon fishing opportunities in the Strait of Georgia PFMA's are predominately shaped by in-season escapement information, test fishing data, commercial harvesting data from Johnstone Strait fisheries when available, and coast-wide allocations of Chum salmon. When escapement goals are achieved (Table 3-2) or stock abundance allows, commercial gill net, purse seine and troll fisheries can be permitted. As mentioned, the exception is Area 14 where a pre-season forecast of returning Chum abundance is used in addition to the in-season information listed above, to guide management decisions on fishing opportunities (CDFO 2010).

Table 3-2. Current spawning escapement goal, hatchery requirements and overall escapement goal for Chum salmon returning to the Strait of Georgia by PFMA's and system.

PFMA	System	Spawning Escapement Goal	Hatchery Requirements	Overall Escapement Goal
Area 14	Puntledge River	60,000	10,000	300,000
	(Big) Qualicum River	100,000		
	Little Qualicum River	130,000		
Area 16	Jervis Inlet Streams	n/a	n/a	110,000
Area 17	Nanaimo River	n/a	n/a	60,000
Area 18	Cowichan River [1]	n/a	n/a	160,000
Area 19	Goldstream River	n/a	n/a	15,000

(1) Cowichan River Chum has an escapement target.
(n/a) not applicable.

Fishing opportunities in the Strait of Georgia are constrained by concerns over bycatch of passing Chum salmon stocks and local Chinook and Coho salmon populations. These concerns are addressed by Area specific pre- and in-season management measures that may include:

- *area closures*: beach boundaries and limiting fisheries to terminal areas to minimize impacts on passing stocks; and,
- *non-retention*: of Chinook and Coho salmon.

As well, to reduce bycatch mortality and to improve the quality of catch data, additional pre-and in-season management measures may be implemented in the Strait of Georgia fisheries. These additional measures may include:

- *daylight fishing only*: in the gill net fishery;
- *maximum soak time*: in the gill net fishery;
- *mandatory brailing*: in the seine fishery;
- *barbless hooks*: in the troll fishery; and,
- *on-board observers*: if high bycatch occurs.

Pre- and in-season management measures aimed at reducing bycatch mortality are commonly implemented after consultation with the Chum Working Group.

First Nations FSC fisheries remain a priority and occur in terminal areas targeting individual populations from river systems within or adjacent to band territories. Harvest limits may be set when there are conservation concerns for the target population; however, First Nations FSC fisheries have priority over other fisheries. Generally, catch and effort in First Nations FSC Chum salmon fisheries is low compared to commercial Chum salmon fisheries.

Although tidal recreational fisheries are open throughout the Strait of Georgia, Chum salmon are not commonly targeted by recreational anglers. Nevertheless, the Strait of Georgia recreational Chum salmon catch is estimated annually through a Creel Survey conducted by CDFO. In most years, the Creel Survey operates from the beginning of May through to the end of September. Data from this survey is compiled and analyzed to produce catch and effort statistics by Area for each salmon species. Non-tidal recreational fisheries vary by Area and are considered if escapement and FSC needs have been met.

3.3.2.1 Area 14 Chum Salmon Management Strategy

Chum salmon returning to Area 14 have been enhanced since the late 1960's and terminal fisheries targeting the enhanced Chum salmon populations of Puntledge, (Big) Qualicum and Little Qualicum rivers have occurred in October and November since the early 1970's. Returning Area 14 Chum salmon abundance is forecasted pre-season using brood escapement, average survival and age composition. In-season run strength is assessed from any early catch information, visual observations at river estuaries and escapement counts to the three enhanced river systems.

The spawning escapement goals for Chum salmon to the three river systems are 60,000 to Puntledge River, 100,000 to (Big) Qualicum River and 130,000 to Little Qualicum River; including enhancement facility requirements of 10,000, the overall escapement goal is 300,000 Chum salmon for Area 14 (Table 3-2). Spawning escapements are monitored by CDFO Stock Assessment and hatchery staff.

The recommended approach regarding Chum salmon-directed fishing opportunities in Area 14 is made at the first meeting of the Chum Working Group. This meeting is tentatively scheduled for the first week of October; Chum Working Group meetings are subsequently held every week until late November.

Commercial Chum salmon-directed fisheries have a specific harvest strategy, implemented since 1981 that consists of limited early harvest prior to any escapement occurring. The allowable early Chum salmon harvest is set at 65% of the predicted surplus. The predicted surplus is calculated by subtracting the overall escapement goal (300,000; Table 3-2) and a buffer (100,000) from the pre-season terminal run size forecast (CDFO 2010). The buffer safeguards against errors in the pre-season forecast of Area 14 stock abundance.

The limited early commercial harvest of Chum salmon is planned pre-season and executed in-season in the second or third week of October based on whether a surplus, using the formula described above, is identified. However, if catches in the commercial Chum salmon fisheries in Johnstone Strait indicate low Chum salmon abundance, a decision on the approach in Area 14 may be deferred until the following week.

The management objectives for Area 14 are:

- achieve Area 14 chum escapement requirements of 300,000;
- ensure adequate Chinook and Coho escapements to Area 14 enhancement facilities;
- provide access to First Nations for FSC purposes;
- minimize the harvest of passing salmon populations;
- maximize economic return;
- work towards south coast Chum salmon allocation targets for gill net, seine net and troll sectors;
- attempt to manage initial fisheries in Area 14 to avoid large surpluses (i.e. greater than 100,000).

Starting in the second or third week of October, opportunities for gill net, seine net and troll fisheries are based on pre-season forecasts, in-season catch per unit effort (CPUE) information from commercial Chum salmon fisheries in Johnstone Strait, and escapement information. Escapement information becomes increasingly important when considering further commercial opportunities in the latter part of October. These commercial opportunities are determined at the weekly Chum Working Group meetings and may include consideration for:

- *limited effort seine net fishery*: a limited effort seine fishery with a harvest target will be considered from late October to late November, based on Chum salmon escapement,

abundance in the approach areas and South Coast allocation guidelines. Full fleet opportunities may also be available;

- *expanded gill net and troll fishery*: if gear counts indicate a modest fleet size of 50 vessels or less, gill net and troll openings may be expanded beyond one to two days per week; as well, additional fishing opportunities for gill net and troll may be considered following the seine net fisheries; and,
- *additional fishing days*: additional fishing days are considered if fishing time is lost due to poor weather conditions.

Once spawning escapement goals and hatchery requirements have been achieved, any returns above the overall escapement goal may be harvested (CDFO 2010).

Commercial fishing opportunities are constrained by concerns over local and passing Chinook, Coho and Chum salmon populations. Management measures to address these concerns can include:

- *area closures*: beach boundaries to protect Chinook and Coho salmon (boundaries may range from half a mile to one and a half miles depending upon bycatch concerns and time of year); French Creek radius boundary and Baynes Sound area closures to protect wild Chum and Coho salmon populations;
- *non-retention*: of Coho salmon;
- *maximum soak time*: in the gill net fishery;
- *mandatory brailing*: in the seine fishery;
- *barbless hooks*: in the troll fishery;
- *daylight fishing only*: in the gill net fishery if there are significant levels of bycatch; and,
- *outside boundaries*: designed to minimize impacts on passing salmon populations.

First Nations FSC fisheries are conducted in Area 14 and at the enhancement facilities prior to consideration of ESSR fisheries targeting Chum salmon. Tidal recreational fisheries are subject to the normal daily and possession limits for Chum salmon (daily limit four per day/possession limit eight) and are open throughout the Area.

Once escapements have been confirmed, non-tidal recreational fisheries for Chum salmon in the Puntledge and (Big) Qualicum rivers will be considered. These fishing opportunities may occur as early as the second to fourth week of October and are based, in part, upon in-season and past return timing of Chum salmon.

3.3.2.2 Area 16 Chum Salmon Management Strategy

Area 16 Chum salmon-directed fisheries target wild chum salmon populations returning to river systems in the Jervis Inlet area. The main systems are Tzoonie, Deserted and Skwawka Rivers.

The overall escapement goal for Jervis Inlet streams is 110,000 Chum salmon (Table 3-2). Terminal fisheries occur when achieving the individual or overall escapement goal has been assured. Assessment in the area is conducted by CDFO Charter Patrol vessels, CDFO Stock Assessment, and members of the Sechelt Indian Band.

Due to the inability of pre-season forecasts to reliably predict returns of Area 16 Chum salmon, pre-season fishing plans are not developed for Area 16 (CDFO 2010).

In-season management is guided by advice from the Chum Working Group. Commercial fishing opportunities are evaluated at the Chum Working Group's weekly meetings where in-season data is reviewed. Fishing opportunities are also affected by coast-wide allocations of Chum salmon.

The potential implementation of a limited fleet-size (e.g. three to five vessels) weekly assessment fishery in the lower Jervis Inlet area is being explored by the CDFO with domestic gill net and troll commercial harvest committees. A weekly assessment fishery in the last two weeks of October and the first week of November may, over time, provide an earlier indication of overall abundance returning to this Area (CDFO 2010).

Full fleet Chum salmon fishing opportunities will be provided in an area when the escapement goals have been achieved; achievement of the escapement goals includes combining estimates of Chum salmon in-river and the estimate of Chum salmon inside a designated sanctuary area (CDFO 2010). The earliest potential fishing opportunity is usually anticipated near the end of October.

Chum salmon fishing opportunities are constrained by concerns over fishing impacts on Coho salmon and passing Chum salmon populations. To address these concerns, there is mandatory non-retention of Coho salmon and fishing is limited to terminal areas.

Historically, Chum salmon fishing opportunities in Area 16 do not occur on a regular basis. There have been no fisheries in Area 16 in recent years.

3.3.2.3 Area 17 Chum Salmon Management Strategy

Chum salmon fisheries in Area 17 are directed primarily at Nanaimo River populations. On poor return years, the Nanaimo River Chum salmon stock is supplemented by production from the Nanaimo River Hatchery.

The overall escapement goal for the Nanaimo River is 60,000 Chum salmon (Table 3-2). Chum salmon escapement estimates are derived from a combination of helicopter surveys, joint DFO/Snuneymuxw in-river assessments, charter patrol ground surveys of approach and terminal areas and fishery officer patrols of the river.

Pre-season forecasts of Chum salmon abundance are helpful in defining possible opportunities, but decisions to open commercial fisheries are not based on pre-season information (CDFO 2010). Area 17 Chum salmon are managed as a component of the "mixed-stock harvest strategy" for Chum salmon and in-season management is guided by advice from the Chum Working Group as outlined for Areas 14 and 16. Fishing opportunities are planned in-season

based on escapement information and shaped by coast-wide allocations of Chum salmon. Escapements can fluctuate annually and fishery opportunities are evaluated during the weekly in-season review of Nanaimo escapement estimates within the Chum Working Group process.

Opportunities for gill net, troll and seine net fisheries are discussed once Chum salmon have started to enter the Nanaimo River and are present in terminal areas. Final decisions are made at the weekly Chum Working Group meetings. If commercial opportunities are identified, management will be guided by the following considerations:

- gill nets open for one or two days; fishing days and opening duration subject to escapement levels;
- troll open seven days per week due to a demonstrated low catch rate;
- after initial opening, continued fishing opportunities depend upon information derived from CPUE in the commercial fisheries, and on-going approach area and in-river assessments;
- if harvest remains "good" and the escapement goal is reached, commercial fisheries can continue; and,
- additional fishing days will be considered if time is lost due to poor weather conditions.

Commercial fishing opportunities are constrained by concerns over domestic Chinook & Coho salmon populations and passing Chum salmon. Management measures to address these concerns can include:

- *area closures*: subarea boundaries protecting migrating Fraser River Chum salmon and confine the fishery to the Nanaimo River stock;
- *non-retention*: of Coho and Chinook salmon;
- *maximum soak time*: in the gill net fishery if Coho salmon encounters are high;
- *barbless hooks*: in the troll fishery; and,
- *daylight fishing only*: in the gill net fishery if there are significant levels of bycatch.

In-season management measures aimed at reducing bycatch mortality (e.g. maximum soak time and daylight fishing only in the gill net fishery) would be implemented after consultation with the Chum Working Group.

First Nations FSC fisheries as well as tidal/non-tidal recreational fisheries are conducted on these Area 17 populations. Local FSC opportunities are undertaken by Nanaimo First Nations in consultation with the Department. Tidal recreational fisheries are subject to the normal daily and possession limits and there are no closed areas. There are no opportunities for non-tidal recreational fisheries in the Nanaimo River.

3.3.2.4 Area 18 Chum Salmon Management Strategy

Area 18 Chum salmon-directed fisheries target primarily Cowichan River Chum populations although Goldstream River Chum salmon are also harvested to some extent. Commercial fishery

openings in mid to late November are limited to Satellite Channel to minimize impact on the earlier timed Goldstream River populations. Chemainus River Chum salmon populations are also impacted but likely to a lesser extent (CDFO 2010).

A revised overall escapement target of 160,000 has been set for Cowichan River Chum salmon (Table 3-2). The revised Chum salmon target is based on habitat area and Chum salmon spawning densities in the Cowichan River (CDFO 2010). In-river Chum salmon escapement estimates are provided by the operation of a DIDSON Counter (Dual-frequency Identification Sonar) located in the lower river.

Pre-season forecasts of abundance are helpful in defining possible commercial opportunities, but decisions to open commercial fisheries are not based on pre-season information (CDFO 2010). In-season management is guided by advice from the Cowichan Fisheries Roundtable (the Roundtable) and the Chum Working Group. Commercial fishing opportunities are evaluated during the weekly in-season meetings of the Roundtable and the Chum Working Group and are shaped by coast-wide allocations of Chum salmon.

The Cowichan Harvest Roundtable's goals are to identify potential commercial fishing opportunities earlier in the run timing, to harvest any identified surplus throughout the run-curve (instead of cropping the surplus from the end of the run), and to be able to make decisions quickly so that fisheries can be initiated in a timely manner (CDFO 2010).

Commercial fishery openings are planned in-season based on in-season escapement estimates, and the assessment of marine abundance through an Area 18 test fishery and/or over-flights, and are shaped by the coast-wide allocations of Chum salmon (CDFO 2010). The following guidelines are used in-season to manage the commercial fisheries directed at Area 18 Chum salmon:

- 25,000 Chum salmon enumerated in the Cowichan River triggers the start of the Area 18 seine net test fishery;
- over-flight and Area 18 seine net test fishery information will be used in conjunction with upper river spot indicators to determine whether the remainder of the escapement goal is expected to be achieved;
- small gill net and troll fisheries may be initiated on short notice if in-stream migration numbers and marine approach area abundance warrants an opening;
- troll fisheries may open seven days per week due to demonstrated low catch rates;
- sustained in-river Chum salmon migration and Chum salmon abundance in the marine area that indicates a higher probability of reaching escapement goals, may trigger a seine net fishery;
- subject to fishery review and continued escapements, commercial fisheries may continue and opening types will be adjusted to meet overall guidelines; and,
- specific fishing dates and boundaries will be determined in-season through the Roundtable and Chum Working Group process; timing of migration is important in terms of the health of the run and in relation to interception of Goldstream River Chum salmon in the Area 18 fisheries.

Like other Strait of Georgia PFMAs, commercial fishing opportunities in Area 18 are constrained by concerns over domestic Chinook & Coho salmon populations and passing Chum salmon. Management measures to address these concerns can include:

- *area closures*: subarea boundaries to protect Coho salmon holding off Cherry Point; limiting commercial fisheries to Satellite Channel to minimize impact on the earlier timed Goldstream River Chum salmon populations; beach boundaries to protect Chinook and Coho salmon;
- *non-retention*: of Coho salmon;
- *maximum soak time*: in the gill net fishery if Coho salmon encounters are high;
- *mandatory brailing*: in the seine net fishery;
- *barbless hooks*: in the troll fishery; and,
- *daylight fishing only*: in the gill net fishery if there are significant levels of bycatch.

In-season management measures aimed at reducing bycatch mortality (e.g. maximum soak time and daylight fishing only in the gill net fishery) would be implemented after consultation with the Roundtable and the Chum Working Group.

First Nations FSC fisheries and tidal/non-tidal recreational fisheries are conducted on these Area 18 Chum salmon populations. Tidal recreational fisheries are subject to the normal daily and possession limits. Non-tidal recreational fisheries will also be considered if escapement targets and First Nations FSC needs are achieved.

3.3.2.5 Area 19 Chum Salmon Management Strategy

Chum salmon fisheries are directed primarily at Goldstream River populations although some Cowichan River Chum salmon are also harvested. The overall escapement goal for Goldstream River is 15,000 Chum salmon (Table 3-2). Goldstream River is a relatively small system with good viewing conditions; as such, escapement estimates are derived from stream walks.

Due to the inability of pre-season forecasts to reliably predict returns of Area 19 Chum salmon, pre-season fishing plans are not developed for Area 16. In-season management is guided by advice from the Chum Working Group. Commercial fishing opportunities are evaluated at the Chum Working Group's weekly meetings where in-season data is reviewed. In-season escapement information forms the basis for determining commercial fishing opportunities. Area 19 falls under the same management regime as other Strait of Georgia PFMA's; consequently, fishing opportunities are also shaped by coast-wide allocations of Chum salmon.

If commercial opportunities are identified, the following guidelines are used in-season to manage the commercial fisheries directed at Area 19 Chum salmon:

- seine and gill nets will alternate fishing days subject to escapement estimates and the entire Chum Working Group review process and status in the coast wide gear type allocation;

- after the initial opening, continued commercial fishing opportunities will depend upon information derived from CPUE in the commercial fisheries, and on-going approach area and in-river assessments, as well as encounters of Chinook and Coho salmon;
- if harvest remains good in the commercial fishery and the overall escapement goal is reached, commercial fisheries may continue; and,
- any economic opportunity (EO) fishery for Saanich Tribes will be conducted separately from FSC fisheries under the same priority and similar rules as the commercial fishery; salmon harvested in any EO fishery will be off-set with licences retired from the commercial sector.

Commercial fishing opportunities in Area 19 are constrained by concerns over domestic Chinook & Coho salmon populations and passing Chum salmon. Management measures to address these concerns can include:

- *area closures*: subarea boundaries to protect Goldstream River Chinook and Coho salmon holding at Squally Reach and minimize encounters of Cowichan River Chum salmon; commercial fishery openings set for mid to late November are limited to portions of Saanich Inlet that are outside or to the north of Squally Reach;
- *non-retention*: of Coho and Chinook salmon;
- *maximum soak time*: in the gill net fishery if Coho salmon encounters are high;
- *mandatory brailing*: in the seine net fishery;
- *barbless hooks*: in the troll fishery;
- *daylight fishing only*: in the gill net fishery if Coho salmon encounters are high;
- *selective fishing techniques*: commercial fisheries will utilize selective fishing techniques to minimize bycatch impacts; and,
- *on-board observers*: on-board observers could be employed if high bycatch occurs.

3.3.3 Fraser River Chum Salmon Management Strategy

The management strategy for Fraser River Chum salmon includes management goals and harvest allocation objectives for Chum salmon fisheries occurring within the Fraser River. Fisheries are structured to ensure a spawning escapement of 800,000 Chum salmon using in-season information derived from the CDFO Albion Chum salmon test fishery (see section 3.3.3.1). Decision rules that guide the management of Fraser River Chum salmon fisheries are summarized in Table 3-3.

Additionally, management of in-river Chum salmon fisheries is guided by the need to minimize impacts on co-migrating stocks of concern, including Interior Fraser Coho salmon and Interior Fraser Steelhead. In order to limit incidental impacts on Interior Fraser Coho salmon, fishing for all sectors (First Nations, recreational, and commercial) is restricted from early September to mid-October within the Fraser River mainstem below Sawmill Creek. Conservation measures taken to protect Interior Fraser Steelhead are developed in conjunction with the B.C. Ministry of

Environment on an annual basis, and are primarily focused on reducing the impact of Fraser River commercial gill net fisheries. In recent years, these restrictions have resulted in the delay of commercial fishing opportunities for Chum salmon until late October, with the exception of those fisheries that operate with selective gear.

Table 3-3. Key decision points for Fraser River Chum salmon management.

Terminal Abundance	Harvest Plan	First Nations	Commercial	Recreational
<800,000 in Fraser	<10%	Limited (reduced hours and days/week fishing)	Closed	Mainstem Fraser River closed, restricted openings on tributaries
800,000-916,000 in Fraser	Harvest not to exceed 81,000 (72,000 First Nations and 9,000 test fishing)	Normal (72,000)	Closed	Mainstem Fraser River open, restricted openings on tributaries
916,000-1,050,000 in Fraser	Commercial harvest not to exceed 10% for Chum	Normal (72,000)	Open (35,000-105,000)	Open
>1,050,000 in Fraser	Commercial harvest not to exceed 15% for Chum	Normal (72,000)	Open	Open

3.3.3.1 Fraser River In-season Terminal Abundance Estimation

Terminal abundance of Fraser River Chum salmon is estimated using a Bayesian model that incorporates pre-season information on run size and migration timing, with in-season information on Chum salmon catch from the Albion Chum salmon test fishery (Gazey and Palermo 2000).

The Albion Chum salmon test fishery has operated annually since 1979 on the lower Fraser River in Area 29 at Albion (near Fort Langley). The test fishery is conducted with a drifted gill net at a specific site near the old Albion ferry crossing. The test fishery begins in early September of each year, and usually fishes until the end of November. On each day of operation, the boat fishes two sets, timed to coincide with the daily high tide. The Albion Chum salmon test fishery normally fishes every other day from September 1st through October 20th, alternating days with the Albion Chinook salmon test fishery (which fishes an 8" mesh gill net during this period). From October 21st through the end of November, the Chum salmon test fishery operates daily. The gill net used in the Albion Chum salmon test fishery is 150 fathoms long, constructed from uniform 6.75" mesh

The first in-season estimate of terminal Fraser River Chum salmon abundance is typically provided in mid-October. Limited First Nations FSC fisheries for Fraser Chum salmon may be permitted prior to this date, unless a conservation concern has been identified.

3.3.4 West Coast Vancouver Island Chum Salmon Management Strategy

Chum salmon stocks return to all areas on the West Coast of Vancouver Island (WCVI). When stock abundance allows, commercial Chum salmon fisheries are conducted in the marine waters outside Nitinat Lake (Area 21), Barkley Sound (Area 23), Clayoquot Sound (Area 24) and Outer Nootka Sound/Tlupana and Esperanza Inlet (Areas 25). Both commercial gill net and purse seine fleets target WCVI Chum salmon in these Areas.

A pre-season forecast of the return of WCVI Chum salmon is predicted for population aggregates corresponding to CDFO's Pacific Fishery Management Areas. Natural and enhanced returns are approximated through separate models and summed to produce a total return forecast for each Area. However, the relative inaccuracy of the pre-season forecasts resulted in the adoption of a fixed harvest rate strategy in the early 2000's for those fisheries targeting wild or mixed stock aggregates.

With the exception of near-terminal areas, such as Nitinat (Area 21 & 22) or Tlupana Inlet (Area 25) where hatchery stocks dominate, WCVI Chum salmon fisheries are currently managed to an exploitation rate of approximately 20% or less. Exploitation is controlled by limiting fishing effort to specific areas, specific times or to a specific number of vessel fishing days per week. Purse seine opportunities generally occur when excess salmon to spawning requirements (ESSR) are identified in near terminal areas (e.g. hatchery stocks returning to Nitinat River or Tlupana Inlet).

Since the late 1990's, most of the commercial harvest has occurred offshore of Nitinat Lake (Area 21) or in Nootka Sound/Tlupana Inlet (Area 25). However, starting in 2004, the commercial gill net sector conducted limited small fleet fishing opportunities for Chum salmon in terminal areas other than Nitinat and Nootka/Tlupana. The intent was to determine if small scale gill net fisheries could be economically viable while limiting exploitation rates to 10 to 20% of returning stocks. Additionally, it was expected these limited fleet fisheries could provide useful stock assessment information. Areas of interested included: Barkley Sound (Area 23), Clayoquot Sound (Area 24), and Esperanza Inlet (Area 25).

WCVI First Nations FSC fisheries remain a priority and occur in terminal areas targeting individual populations from river systems within or adjacent to band territories. Harvest limits may be set when there are conservation concerns for the target population; however, First Nations FSC fisheries have priority over other fisheries. Generally, harvest and effort in First Nations FSC Chum salmon fisheries is low compared to commercial Chum salmon fisheries.

Chum salmon are not commonly targeted by recreational anglers on the WCVI . Nevertheless, the WCVI recreational Chum salmon catch is estimated annually through a Creel Survey conducted by CDFO. Creel Survey information is augmented by logbook and manifest records of catch and effort submitted by lodges operating guided fishing trips on the WCVI. These data are compiled and analyzed to produce catch and effort statistics by Area for each salmon species.

3.3.4.1 Nitinat Chum Salmon Management Strategy

Of importance to the Pacific Salmon Treaty is the WCVI group of Chum salmon populations returning to the Nitinat watershed (Nitinat River and Nitinat Lake & tributaries). This Nitinat stock is the most significant WCVI group of populations and includes production from a major CDFO hatchery on the Nitinat River.

The Nitinat commercial Chum salmon fishery (Area 21), along with the test fishery and ESSR fisheries (Area 22), is the largest fishery on the WCVI and targets returning Nitinat River hatchery Chum salmon. In the past, catch of non-WCVI Chum salmon has occurred in the outside seaward portion of the Nitinat fishing area. Management actions have been implemented to reduce this catch of non-WCVI Chum salmon by restricting the Nitinat fishery to subareas closer to the terminal area (i.e. outlet of Nitinat Lake). More recently, First Nations' ESSR harvests have occurred within Nitinat Lake (Area 22). Historical Chum salmon harvest is shown in Table 3-10.

The spawning escapement target for Chum salmon returning to the Nitinat system (i.e. Nitinat River and other tributaries to Nitinat Lake) has been set at 175,000 fish (CDFO 2010). The target distribution of this spawning escapement between Nitinat River and the tributaries to Nitinat Lake has varied slightly over the last number of years; currently it is set at 125,000 into the Nitinat River and 50,000 into other Nitinat Lake tributaries. This spawning escapement requirement is set at a level to ensure that all run timing components are represented. Additional allocation for First Nations FSC requirements and hatchery requirements (i.e. broodstock) may total up to 50,000 Chum salmon. Consequently, the *gross escapement requirement* (spawning escapement + FN FSC requirements + hatchery requirements) for this Nitinat group of populations is 225,000 Chum salmon (CDFO 2010). Historical Chum salmon escapements are shown in Table 3-10.

A pre-season forecast of current year returns for the Nitinat stock is approximated based on broodyear escapements, estimated freshwater production from natural spawners, hatchery production, average age at return, environmental and ocean condition factors during brood ocean entry and estimated marine survival of each brood year class.

A pre-season fishing plan is commonly developed by the end of the summer and is based on the forecast of current year returns. Opportunities for gill net and limited effort purse seine fishing in the early portion of the fishery (early to mid October) may be provided with an allocation target of 75% gill net and 25% purse seine; the overall fishery allocation target is 30% gill net and 70% seine. If the forecast surplus is low, a gill net test fish program outside Nitinat Lake may be implemented to provide additional abundance information. Depending on in-season test fishing results, achieving escapement milestones into Nitinat Lake, and on the harvest allocation between the two net fisheries, these early opportunities may be followed later in the season by the traditional full fleet purse seine and gill net fisheries (CDFO 2010).

In addition to concerns over catch of non-WCVI Chum salmon, early season opportunities are constrained by concerns over bycatch of Interior Fraser River Steelhead (Thompson River) and passing stocks of Coho salmon. Since 1995, these bycatch concerns in the commercial Nitinat fishery have been addressed by:

- *delayed opening dates*: the first commercial gill net fishery, if conducted, has been delayed until the beginning of October since 1998;
- *reduced fishing areas*: the traditional fishing area has been reduced to within a one-mile boundary between lines true south from Pachena and Dare Points (a portion of Area 21);
- *increased use of weed lines*: a 1.2m - 2.0m weed line for gill nets; and,
- *species selective fishing techniques*: non-retention of Coho salmon and Steelhead.

Additionally, to reduce bycatch mortality and to improve the quality of catch data, the following measures have been implemented in the Nitinat fisheries:

- *daylight fishing only*: gill net fishery;
- *mandatory functional revival tanks*: in purse seine and gill net fisheries;
- *on-board observers*: portions of purse seine and gill net fleet; and,
- *logbooks and weekly hail-ins*: purse seine and gill net fisheries.

The in-season management of the Nitinat fisheries (Area 21 & 22) are based on achieving the *gross escapement requirement* into the Nitinat watershed. A gill net test fishing vessel (operating in Nitinat Lake), broodstock collection success, hatchery swim-ins, and visual surveys of Nitinat River spawners are used to determine whether the weekly *escapement milestone levels* into Nitinat Lake are achieved (CDFO 2010). Weekly fisheries are generally scheduled in Area 21 and surrounding waters to harvest any identified surplus.

First Nations FSC fisheries remain a priority and occur in terminal areas of Nitinat (Areas 21 & 22). First Nations ESSR fisheries can also occur in Nitinat Lake (Area 22) targeting returns surplus to spawning and hatchery requirements.

3.4 Annual Fishery Descriptions

Fisheries targeting Chum salmon in Johnstone Strait, the Strait of Georgia, the Fraser River and on the West Coast of Vancouver Island (WCVI) generally begin in late September and end in November. These fisheries are directed at fall Chum salmon.

In addition to these directed fisheries, a bycatch of Chum salmon may occur in fisheries directed at Sockeye and Pink salmon earlier in the season. This Chum salmon bycatch is assumed to be comprised mainly of summer Chum salmon. The summer Chum salmon harvest in boundary area fisheries are presented in Table 3-4.

Pre-season expectations for Southern B.C. fall Chum salmon stocks was for an average to below average return in 2010. This was based on an above average parental brood abundance in 2006 tempered by the anticipation of reduced marine survival for the out-migrating Chum salmon juveniles in the spring of 2007; these juveniles would typically form the dominant age class of the returns in 2010. Evidence for reduced marine survival of Chum salmon juveniles that entered the marine environment in 2007 was exhibited in very weak Pink and Coho salmon

returns in 2008; juveniles for these species returns in 2008 would have entered the marine environment in 2007 with the brood from the 2006 Chum salmon returns.

Table 3-4. Estimated harvest of summer Chum salmon by PFMA for commercial, research and test fishing vessels [1] (July through the second week of September), 2001–2010.

Year	Statistical Weeks	Pacific Fishery Management Area					
		18	19	20	21	29 [2]	Total
2001	7/1–9/2	0	0	26	0	77	103
2002	7/1–9/2	0	0	37	0	197	234
2003	7/1–9/2	0	0	27	0	54	81
2004	7/1–9/2	0	0	17	0	686	703
2005	7/1–9/2	0	0	0	0	115	115
2006	7/1–9/2	0	0	52	0	419	471
2007	7/1–9/2	0	0	0	0	49	49
2008	7/1–9/2	0	0	0	0	67	67
2009	7/1–9/2	0	0	0	0	27	27
2010	7/1–9/2	0	0	16	0	384	400
Averages		0	0	18	0	208	225

(1) Does not include PSC test fisheries harvest.
(2) Majority of this harvest is fresh water based and likely of Fraser River origin.

The following sections describe the fisheries directed at fall Chum salmon in each of the Southern B.C. areas in 2010.

3.4.1 Johnstone Strait

The Johnstone Strait test fishery provided timing and index of abundance information of the 2010 return which is important for assessing the performance of the 20% fixed harvest strategy implemented in the Johnstone Strait fisheries. It also provided an index of abundance that was used to determine the likelihood of whether the abundance of returning Chum salmon is over the 1.0 million critical abundance level required to continue with commercial openings. Extremely low catch per unit effort in the test fishery was confirmed by the extremely low catch in the 1st planned purse seine opening in the beginning of October. The indices of abundances were reviewed and it was determined that the returning abundance was likely lower than the critical threshold required for continuation of commercial fisheries. All subsequent commercial openings in Johnstone Strait were suspended. Age composition derived from the test-fishery samples demonstrated a very low contribution of the typically dominant 4-year old brood component. This was more evidence of the poor survival conditions encountered by the 2007 out-migration component of this return. Planned commercial fisheries were subsequently suspended for the duration of the season. Table 3-5 outlines the duration and Chum salmon harvest, of fishery openings during the 2010 season prior to the suspension of the commercial Chum salmon fisheries.

In 2010, before the suspension of commercial fisheries, there were two competitive commercial Chum salmon fisheries in Johnstone Strait (Area 12 and Area 13) and one troll individual transferable quota (ITQ) fishery. The total 2010 commercial harvest for Johnstone Strait, including test fishery harvest, was 55,511 Chum salmon (Table 3-5). There were no directed commercial Chum salmon fisheries in the terminal areas of Johnstone Strait. Recreational harvest was low in Johnstone Strait (estimated at 899 Chum salmon; Table 3-5) with little monitoring during the month of October. First Nations FSC harvest was estimated at 4,060 in the Johnstone Strait area (Table 3-5). The total estimated harvest of Chum salmon in Johnstone Strait in 2010 was 60,470.

Table 3-5. Estimated Chum salmon harvest from Chum salmon-directed fisheries occurring in Johnstone Strait by PFMA, 2010.

Gear Type	Area	Fishery Dates		Fishery Duration (hours)	Estimated Harvest
		Start	End		
Purse Seine (Test)	12	Sep. 20	Oct. 26	n/a	1,011
Purse Seine	12	Oct. 4	Oct. 4	12	18,030
	13	Oct. 4	Oct. 4	12	19,156
Gill Net	12	Oct. 6	Oct. 8	41	11,416
	13	Oct. 6	Oct. 8	41	5,548
Troll [1]	12	Sep. 27	Oct. 9	n/a [1]	37
	13	Sep. 27	Oct. 9	n/a [1]	313
Recreational [2]	12	n/a	n/a	n/a	0
	13	n/a	n/a	n/a	899
First Nations [2]	12	n/a	n/a	n/a	602
	13	n/a	n/a	n/a	3,458
Total					60,470

(1) The troll fishery was opened from Sep. 27 to Oct. 9. The fishery was an effort based quota over that time period.
(2) The recreational and First Nation fisheries time periods varied over the season.

3.4.2 Strait of Georgia

In 2010, with in-season information from the Johnstone Strait test fishery indicting a low Inside Southern Chum salmon abundance, it was highly unlikely that terminal opportunities would be available for any harvestable surplus. During the fall monitoring program, there were no observed Chum salmon escapements over established goals to initiate terminal fisheries. The only harvest of Chum salmon was a small sample taken during the Cowichan test fishery (PFMA 18; Table 3-6) that confirmed the general low abundance throughout the area.

The recreational creel survey within the Strait of Georgia area was not conducted after September in 2010. However, based on the low abundance of Chum salmon throughout the Inside Southern Chum salmon area, recreational catches would have been extremely low after September.

The harvest by First Nations in the Strait of Georgia in 2010 was estimated to be 1,218 Chum salmon (Table 3-6).

Table 3-6. Estimated Chum salmon harvest from Chum salmon-directed fisheries occurring in the Strait of Georgia by PFMA, 2010.

Gear Type	Area	Fishery Dates		Fishery Duration (hours)	Estimated Harvest
		Start	End		
Purse Seine (Test)	18-19	Oct. 25	Nov. 23	n/a	225
Recreational [1]	14-19, 28, 29 [3]	May 1	Sep. 30	n/a	0
First Nations [2]	15	n/a	n/a	n/a	408
	16	n/a	n/a	n/a	40
	18	n/a	n/a	n/a	200
	28	n/a	n/a	n/a	570
Total					2,229

(1) The recreational fishery was not monitored after September; harvest of Chum salmon was likely very low.
(2) The First Nation fisheries time periods varied over the season.
(3) Marine subareas of Area 29; i.e. does not include an estimate for Chum salmon harvest in the tidal portion of the lower Fraser River downstream of Mission BC (Appendix B3).
(n/a) not applicable.

3.4.3 Fraser River

Within the Fraser River, Chum salmon fisheries include: First Nations fisheries; recreational fisheries; and commercial fisheries (including test fisheries). In recent years, significant conservation measures have been implemented in-river during the Fraser River Chum salmon migration period in order to protect co-migrating stocks of concern (Interior Fraser Coho salmon and Interior Fraser Steelhead). Depending on the fishery, these measures have included both time and area closures, as well as gear restrictions.

The escapement objective for Fraser River Chum salmon is 800,000 spawners. As described in section 3.3.3 (*Fraser River Chum Salmon Management Strategy*), Chum salmon fishing opportunities are provided based on in-season information from the CDFO Albion Chum salmon test fishery. In 2010, the initial estimate of terminal abundance of Chum salmon returning to the Fraser River, provided on October 15, was 1,098,000 Chum salmon. An additional update was provided by Canada on October 18, indicating a terminal abundance estimate of 810,000 Chum salmon. Within a week of the initial assessment the estimated terminal abundance had dropped below the 800,000 escapement goal, where it remained for the duration of the season. In response to the poor return, Chum salmon fishing opportunities were limited for all sectors in the Fraser River.

Table 3-7. Estimated harvest of Chum salmon from salmon fisheries occurring in Area 29 (both marine and in-river) and in Region 2 (non-tidal) of the Fraser River, 2010.

Fishing Sector	Fishery Description	Target Species	Fishery Dates		Fishery Duration	Assessment Dates		Estimated Harvest
			Start	End		Start	End	
Test	Albion Chinook	Chinook	Apr. 1	Oct. 20	171 days	n/a	n/a	2,665
	Albion Chum	Chum	Sep. 3	Nov. 23	58 days	n/a	n/a	6,845
	Whonnock Sockeye	Sockeye	Jun. 22	Oct. 6	103 days	n/a	n/a	1,224
	Cottonwood Sockeye	Sockeye	Jul. 12	Oct. 6	83 days	n/a	n/a	28
	Subtotal							10,762
Commercial	Area E Gill Net [1]	Sockeye	Aug.10	Sep.6	10 days	n/a	n/a	165
	Area B Seine Net	Sockeye	Sep.9	Sep.13	5 days	n/a	n/a	39
	Area H Troll	Sockeye	Aug.8	Sep.18	42 days	n/a	n/a	2
		Chum	Oct.16	Oct.19	4 days	n/a	n/a	3
	Subtotal							209
Recreational [2, 3]	Fraser River mainstem	Mixed	Jul. 16	Oct. 21	98 days	Jul. 16	Oct. 15	1,549
	Chilliwack River	Mixed	Jul. 1	Oct. 14	106 days	Sep. 15	Nov. 15	1,142
	Nicomen Slough	Mixed	Jan. 1	Oct. 24	297 days	Oct. 8	Nov. 30	10
	Stave River	Mixed	Jan. 1	Oct. 24	297 days	Sep. 15	Dec. 6	3,578
	Subtotal							6,279
First Nations [1]	FSC	Chinook	Jan.29	Sep.23	238 days	n/a	n/a	0
		Sockeye	Jul.26	Oct.4	71 days	n/a	n/a	3
		Chum	Oct.9	Nov.17	40 days	n/a	n/a	13,477
	ESSR	Chum	n/a	n/a	n/a	n/a	n/a	14,021
	EO [4]	Sockeye	Aug.9	Sep.17	40 days	n/a	n/a	186
		Chum	n/a	n/a	n/a	n/a	n/a	-
	Subtotal							27,687
Total								44,937

(1) Fishery Start and End Dates for the commercial Area E gill net and FN fisheries reflect the first and last date the fisheries were permitted; the fisheries were not necessarily continuous between these dates.

(2) Fishery Start and End Dates for the recreational fisheries reflect the period the area was opened to the retention of Chum salmon; retention of other salmon species may have been allowed beyond these dates.
(3) The recreational estimates are for the periods of the assessments; assessment period may or may not coincide with fishery opening and closing dates.
(4) There were no EO opportunities for Chum salmon in the Fraser River in 2010.
(n/a) not applicable.

First Nations FSC gill net fisheries targeting Chum salmon were initiated October 9, 2010 (below Mission; Appendix B3) and October 11, 2010 (above Mission) following closures to protect co-migrating Interior Fraser Coho salmon. The estimated FSC Chum salmon harvest from Chum directed fisheries was 13,477. First Nations ESSR harvests taken from Fraser River hatchery facilities totaled 14,021 Chum salmon. There were no First Nations Economic Opportunity (EO) fisheries directed at Chum salmon in 2010 (Table 3-7)

In 2010 there were First Nations FSC and EO fisheries targeting Sockeye salmon; these fisheries harvested three and 186 Chum salmon, respectively. First Nations FSC fisheries targeting Chinook salmon did not harvest any Chum salmon (Table 3-7). The total Chum salmon harvested in all Fraser River FN fisheries was 27,687 Chum salmon in 2010 (Table 3-7 and Table 3-8).

Table 3-8. Estimated harvest of Chum salmon from First Nations and commercial salmon fisheries occurring in Area 29 and in Region 2 of the Fraser River, 2001–2010.

Year	First Nations			Commercial			Total
	FSC	EO	ESSR	Area E GN Area B SN Area H TR	Albion and PSC Test Fisheries	Other Scientific Licences [1]	
2001	25,931	38,344	112,920	32,911	14,732	14,197	249,634
2002	12,568	49,910	58,266	49,729	17,086	n/a	194,520
2003	26,970	28,790	41,527	45,365	10,735	n/a	156,618
2004	19,846	50,668	96,682	70,855	16,383	n/a	258,880
2005	7,267	95,527	38,487	56,898	12,920	n/a	212,770
2006	15,150	114,708	93,516	163,757	16,942	n/a	410,350
2007	13,344	77,490	29,884	30,400	7,650	n/a	163,332
2008	31,553	50,004	41,683	38,006	10,155	n/a	176,098
2009	12,991	68,150	8,458	42,116	9,249	n/a	144,163
2010	13,480	186	14,021	209	10,762	n/a	44,925
Average	17,910	57,377	53,544	53,025	12,661	n/a	201,129

(1) Includes "experimental" selective fishing scientific licenses issued under the CDFO Selective Fishing Program.
(n/a) not applicable.

As a result of the in-season information from the CDFO Albion Chum salmon test fishery, significant in-season restrictions on Chum salmon retention in the recreational fisheries were put in place throughout the lower Fraser River watershed in 2010. However, recreational fishery assessments continued as planned to assess the impacts of these fisheries targeting salmon species other than Chum salmon.

The major Fraser River watershed recreational salmon fisheries impacting Chum salmon in 2010 include significant salmon fisheries occurring in the lower Fraser River mainstem and the Chilliwack River and minor salmon fisheries occurring on the Harrison River, the Stave River and the Nicomen Slough/Norrish Creek system. The latter four systems are tributaries to the Fraser River in the lower Fraser Valley and all but the Harrison River recreational fishery was assessed in 2010.

The lower Fraser River mainstem was open to recreational angling on July 16, 2010 and for the retention of Chum salmon to October 21, 2010 (daily retention limit of 2). The Chum salmon closure after October 21 was earlier than normal in response to the in-season indication of poor returns of Fraser River Chum salmon. In 2010, this mainstem recreational fishery was assessed from July 16 to October 15; estimates of 1,549 and 6,242 Chum salmon were harvested and released, respectively (Table 3-7).

The Chilliwack River recreational fishery was open to the retention of Chum salmon from July 1, 2010 to October 14, 2010. The earlier than normal October 15, 2010 closure was to offset the expected poor returns in 2010 due to severe flooding that occurred in the Chilliwack River in the fall of 2006. The Chilliwack River fishery was assessed from September 15 to November 15 in 2010; estimates of 1,142 and 13,322 Chum salmon were harvested and released, respectively (Table 3-7).

The Harrison River, Stave River and Nicomen Slough/Norrish Creek system recreational fisheries were originally open to the retention of Chum salmon year round. However, due to the in-season information from the Albion Chum salmon test fishery indicating poor Chum salmon returns in 2010, there was no retention of Chum salmon permitted after October 24 in these three systems.

In 2010, the Stave River recreational fishery was assessed from September 15 to December 6; estimates of 3,578 and 14,404 Chum salmon were harvested and released, respectively (Table 3-7). Although historically not directed at Chum salmon, the Nicomen Slough/Norrish Creek fishery was assessed from October 10 to November 30 in 2010. Estimates of 10 and 614 Chum salmon were harvested and released, respectively in 2010 for this fishery (Table 3-7). The recreational fishery in the Harrison River was not assessed in 2010.

In total, for assessed recreational fisheries occurring in the lower Fraser River watershed in 2010, estimates of 6,279 and 34,582 Chum salmon were harvested and released, respectively (Table 3-7 and Table 3-9).

Commercial fisheries in the lower Fraser River (i.e. Area E gill net) are closed annually from early September to mid-October during the Interior Fraser Coho migration period. In recent years, this closure has been extended into late October to provide additional protection to Interior Fraser Steelhead. As a result, commercial Area E gill net Chum salmon fisheries now typically occur during the last week of October and first week of November. In 2010, the estimated terminal return of Chum salmon to the Fraser River was below the escapement target, and as a result, there was no commercial surplus identified. Accordingly, there were no Chum salmon-directed Area E gill net commercial openings in the Fraser River in 2010. However, a Chum salmon-directed Area H troll commercial fishery was initiated in some portions of the marine waters of Area 29 on October 16, 2010 prior to information from the Albion Chum salmon test

fishery indicating poor Chum salmon returns. This fishery was originally planned for 7 days but closed early on October 19, 2010. An estimated 3 Chum salmon was harvested from the 4 day Area H troll fishery (Table 3-7).

Table 3-9. Estimated harvest of Chum salmon in assessed (i.e. surveyed) lower Fraser River recreational fisheries, 2001–2010.

Year	Recreational Fishery						
	Fraser River [1]	Chilliwack River	Nicomen Slough	Stave River	Harrison River	Chehalis River	Total
2001	1,371	3,380	54	5,483	311	231	10,830
2002	2,761	4,150	50	ns	ns	ns	6,961
2003	728	2,503	ns	ns	ns	ns	3,231
2004	0	4,384	62	ns	ns	ns	4,446
2005	39	1,624	8	ns	ns	ns	1,671
2006	900	5,375	2	ns	ns	ns	6,277
2007	3,007	1,553	4	ns	ns	ns	4,564
2008*	760	3,937	0	ns	ns	ns	4,697
2009*	43	2,404	10	ns	742	ns	3,199
2010*	1,549	1,142	10	3,578	ns	ns	6,279
Averages	1,116	3,045	22	4,531	527	231	5,216

(1) Mainstem portion of the lower Fraser River (downstream of Hope, B.C.; Appendix B).
(*) Preliminary estimates.
(ns) not surveyed.

Additionally, there was a very large Fraser River Sockeye salmon return in 2010 that provided numerous Sockeye salmon-directed Area E gill net, Area B seine net [1] and Area H troll openings in Area 29; these fisheries harvested an estimated 165, 39 and 2 Chum salmon, respectively, in 2010 (Table 3-7).

The total Chum salmon harvested in Area 29 commercial fisheries (not including test fisheries) was 209 Chum salmon in 2010 (Table 3-7 and Table 3-8).

Four test fisheries operated in the Fraser River in 2010: the CDFO-operated Albion Chinook and Chum salmon test fisheries and the PSC-operated Whonnock and Cottonwood Sockeye salmon test fisheries. While Whonnock and Cottonwood test fisheries target Sockeye salmon, the Albion test fishery assesses abundance of both Chinook and Chum salmon, using different net configurations to target the two different species (section 3.3.3.1).

In 2010, the Albion Chinook salmon test fishery operated from April 1 through October 20, and the Albion Chum salmon test fishery operated from September 3 through November 23. From September 3 to October 20, 2010, the Chinook and Chum test fisheries operated on alternating days (section 3.3.3.1). In 2010, there were 8 days in August and September when the Albion test fisheries did not operate due to gear conflicts associated with Area E Sockeye openings in the Fraser River. Chum salmon harvest in the Albion Chinook salmon test fishery, representing 171

fishing days, totaled 2,665 Chum salmon and harvest in the Albion Chum salmon test fishery, representing 58 days, totaled 6,845 Chum salmon (Table 3-7).

The PSC Whonnock Sockeye salmon test fishery operated daily from June 22, 2010 to October 6, 2010, except on days when there were Area E Sockeye openings in the Fraser River. Chum salmon harvest in this test fishery, representing 103 fishing days, totaled 1,224 Chum salmon. The PSC Cottonwood Sockeye salmon test fishery began on July 12, 2010 and was conducted daily until October 6, 2010, except during Area E Sockeye openings. Chum salmon harvest in this test fishery, representing 83 fishing days, totaled 28 Chum salmon (Table 3-7).

In total, an estimated 10,762 Chum salmon were harvested in the CDFO and PSC test fisheries occurring in the Fraser River in 2010 (Table 3-7 and Table 3-8).

3.4.4 West Coast Vancouver Island

In 2010, due to in-season assessment data that suggested a low abundance of wild and hatchery Chum salmon stocks along the WCVI, there were no full fleet commercial Chum salmon fishing opportunities. However, limited effort gill net fisheries did occur in Areas 23 and 25; harvest totaled 900 and 13,100 Chum salmon, respectively.

First Nations FSC harvest of Chum salmon occurred in all WCVI areas and totaled 17,700 for 2010. By area, Chum salmon harvest was 2,100 in Area 23, 3,400 in Area 24, 700 in Area 25, and 500 in Area 26. There were no First Nation ESSR fisheries in Areas 23-26 in 2010.

3.4.4.1 Nitinat

The pre-season forecast for the 2010 return to the Nitinat watershed was 256,000 Chum salmon (relative to a gross escapement target of 250,000 Chum salmon for the Nitinat system). In-season assessment information provided by the in-lake gill net test fishery, in-lake purse seining for broodstock, and escapement surveys indicated the return was below expected weekly *escapement milestone levels* required to initiate commercial fisheries. As a result, commercial gill net and purse seine fisheries in Area 21 did not occur in 2010 (Table 3-10).

First Nations FSC (Area 21/22) and ESSR (Area 22) harvest of Chum salmon in 2010 totaled 4,800 and 6,163, respectively (note: there were no FN FSC fisheries in Area 21 in 2010). An additional 27,528 Chum salmon were taken for broodstock at Nitinat, and 4,384 Chum salmon were harvested by the gill net test fishery in Nitinat Lake. Recreational fisheries targeting Chum salmon are very limited; harvest in 2010 was estimated at 125 Chum salmon. All Chum salmon removals (i.e. all harvest plus broodstock collections) totaled 43,000 Chum salmon in 2010 (Table 3-10).

Table 3-10. Nitinat area harvest, hatchery broodstock collection and spawning escapement estimates by PFMA, 2001–2010.

Year	Area 21		Area 22	
	Seine Net Harvest	Gill Net Harvest	In-Lake Harvest & Broodstock	Escapement [1] (Natural Spawners)
2001	71,530 *	69,904 *	178,000 *	316,793 R
2002	412,255 *	80,738 R	383,000 *	38,138 R
2003	250,069 *	185,086 *	78,238 R	247,804 R
2004	74,613 *	162,933 *	166,200 R	247,368 R
2005	385,487 R	294,054 R	237,200 R	315,789 R
2006	223,927 R	229,243 R	145,000	155,053 R
2007	0	180,111 R	22,268 R	115,789 R
2008	18,796 R	23,919 *	34,505 *	52,632 R
2009	0	0	32,434 *	54,000
2010	0	0	43,000	59,900
Averages	143,668	122,599	131,982	160,327

(1) includes Nitinat tributaries.
(*) changed from estimates reported in the 2009 Post Season Summary Report (CHUMTC 2011).
(R) significant figure expansion of rounded estimates reported by CHUMTC (2011).

3.5 Escapement

Chum salmon that escape First Nations, commercial (including test fisheries), and recreational fisheries, and any First Nations ESSR harvests, form the escapement totals of spawning Chum salmon for this section of the report. This *net escapement* can include Chum salmon that spawn in natural areas and constructed spawning channels, and those that are used as broodstock in enhancement facilities for hatchery production purposes. For the purposes of this report *spawning escapement* refers to salmon that spawn by their own volition in nature in either a natural (e.g. river) or man made channel (e.g. controlled spawning channel), and does not include salmon used for broodstock.

Some river systems in southern B.C. support summer Chum salmon populations. However, because the summer aggregate is relatively minor when compared to the larger fall aggregate in southern B.C., and due to their distinctively early run timing (e.g. July to late August in Johnstone Strait) allowing for only a minimal bycatch in southern B.C. salmon fisheries (Table 3-4), summer Chum salmon escapement is not included in the escapement totals for this section of the report (i.e. escapement totals in this section refer to fall Chum salmon only).

3.5.1 Inside Southern

The primary enhanced escapement areas are presently limited to the mid-Vancouver Island, Squamish River, Burrard Inlet and Fraser River areas. The enhancement facilities in the mid-Vancouver Island consist of Big Qualicum, Little Qualicum and Puntledge River Hatcheries.

There is one enhancement facility in the Burrard Inlet (Capilano River Hatchery: limited Chum salmon hatchery production), and the Squamish watershed (Tenderfoot Creek Hatchery) and four in the Fraser River watershed (Inch Creek, Chilliwack River, and Chehalis River Hatcheries and Weaver Creek Spawning Channel). Enhancement on the Capilano is opportunistic, only using Chum salmon that return to the hatchery facility for broodstock.

The stocks that are managed within the context of the Inside Southern Chum salmon plan are the fall Chum salmon. These Chum salmon enter Johnstone Strait during the September to November time period. Escapement estimates for these Chum salmon since 2001, are presented in Table 3-11.

Table 3-11. Inside Southern Chum salmon net escapement estimates (spawning escapement plus hatchery broodstock) for Fraser and Non-Fraser stock aggregates, 2001–2010 [1].

Year	Inside Southern Chum Salmon Escapement		
	Fraser River	Non-Fraser River	Total
2001	3,014,752	1,095,473	4,110,225
2002	2,243,216	1,246,208	3,489,424
2003	1,451,961	777,956	2,229,917
2004	2,633,549	1,009,417	3,642,966
2005	1,264,071	558,309	1,822,380
2006	2,026,673	747,654	2,774,327
2007	1,026,701	817,346	1,844,047
2008	940,163	707,731	1,647,894
2009	619,363	825,530	1,444,893
2010	528,066	412,699	940,765
Averages	1,574,852	819,832	2,394,684

(1) Does not include Chum salmon which are surplus to spawning requirements (ESSR) and are removed from the spawning areas as they do not contribute to production in subsequent years. Those Chum salmon are assigned to harvest. Hatchery broodstock removals are included as they contribute to subsequent production.

3.5.2 West Coast Vancouver Island

In 2010, Nitinat Chum salmon spawning escapement was estimated at 59,900 (Table 3-10) continuing the trend of low spawning escapement that began in 2008. In other WCVI Areas, Chum salmon spawning escapements were also low relative to the long-term averages (Table 3-12). Spawning escapement estimates given for Areas 23-26 in Table 3-12 are derived from index system assessments in each Area. From historical surveys of Chum salmon streams in each Area, the proportion each stream contributed (on average) to the total spawning escapement for the Area is estimated. Spawning escapement estimates from index systems currently surveyed annually, are expanded to an Area spawning escapement to account for those streams not surveyed.

Table 3-12. WCVI Chum salmon spawning escapement estimates [1] by PFMA, 2001–2010.

Year	WCVI Pacific Fishery Management Area			
	Area 23 (Barkley)	Area 24 (Clayoquot)	Area 25 [2] Nootka)	Area 26 (Kyuquot)
2001	26,069	59,623	151,765	12,316
2002	158,061	93,595	160,894	22,138
2003	115,974	80,787	118,265	70,228
2004	100,384	141,646	220,772	69,606
2005	79,655	56,544	97,709	51,300
2006	21,820	120,395	58,639	71,131
2007	45,013	78,272	19,022	82,775
2008	22,716	29,113	29,180	30,019
2009	29,690	32,190	78,393	29,839
2010	24,977	43,774	59,826	33,650
Averages	62,436	73,594	99,438	47,300

(1) Index system spawning escapements expanded to total spawning escapement for the Area.
(2) Nootka spawning escapements include hatchery river systems.

4 UNITED STATES CHUM SALMON

4.1 Washington Run Sizes, Catches, and Spawning Escapements

Tables 4-1 through 4-3 provide pre-season forecasts of run size, post-season estimates of run size and post-season estimates of spawning escapement for the Chum salmon runs returning to Puget Sound and coastal Washington areas. The tables provide estimates for three major groupings, which are defined by their return timings (summer, fall, and winter Chum salmon).

Summer Chum salmon pre-season forecast for South Puget Sound for 2010 was estimated at approximately 63,000 fish and is slightly below the average return for the recent 10-year period. The post-season run size assessment of South Puget Sound summer Chum salmon in 2010 was 49,098 fish, or 78% of the pre-season forecast and 73% of the 2001–2009 average post-season return (run-size) (Table 4-1). The combined estimate of Hood Canal and Strait of Juan de Fuca summer Chum salmon post-season run size of 22,265 was greater than double the pre-season forecast but was 67% of the average post-season return of the last ten years (Table 4-1).

Table 4-1. Puget Sound summer Chum salmon pre-season and post-season estimates of run size and estimated spawning escapements, 2001–2010.

Region	Type	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Strait of Juan de Fuca	Pre-Season	941	1,468	3,131	4,739	6,803	8,238	8,566	5,969	5,198	3,991
	Post-Season	3,982	6,981	7,017	9,360	9,735	8,281	3,320	3,565	5,168	9,325
	Escapement	3,955	6,955	6,959	9,341	9,682	8,246	3,295	3,525	5,115	9,261
Hood Canal	Pre-Season	6,871	7,846	10,128	18,078	18,060	19,780	23,729	20,159	18,009	5,998
	Post-Season	13,377	13,170	36,024	95,077	16,165	29,396	12,788	17,571	8,459	12,940
	Escapement	12,044	11,454	35,696	69,995	15,757	26,753	10,781	15,403	7,423	12,742
South Puget Sound [1]	Pre-Season	75,599	155,000	47,788	99,317	38,334	55,300	39,840	64,229	57,352	62,991
	Post-Season	84,111	58,545	49,817	178,199	44,993	78,797	57,786	32,065	25,010	49,098
	Escapement	62,821	46,798	45,945	120,782	24,701	63,345	52,669	20,872	21,659	65,888

(1) South Puget Sound estimates include only commercial harvest and escapement within Puget Sound.

Fall Chum salmon 2010 pre-season forecasts for Puget Sound totaled approximately 1,334,000 fish, or approximately 66% of the 2001–2009 average run size. The post-season assessment of Puget Sound fall Chum salmon was 94% of the forecasted levels overall, with individual regional post-season numbers ranging from 121% (Stillaguamish/Snohomish) to 79% (Nooksack/Samish) of the pre-season forecasted numbers (Table 4-2).

The winter Chum salmon 2010 pre-season forecast for South Puget Sound was approximately 89,300 fish, or 83% of the 2001–2009 average run size. The post-season assessment of this run was 102,235 Chum salmon, or 114% of the pre-season forecast number (Table 4-3).

Paragraph 3 of the Chapter 6, Annex IV of the Treaty requires that Canada and the United States assess catch levels of summer Chum salmon caught during the July 1 through September 15

Table 4-2. Washington fall Chum salmon pre-and post-season estimates of run size and estimated spawning escapements, 2001–2010.

Region	Type	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Willapa Bay	Pre-Season	53,958	79,892	75,817	79,183	63,441	38,754	23,798	40,022	7,139	33,442
	Post-Season	53,545	93,209	84,772	114,756	28,132	23,483	17,678	12,982	17,437	26,726
	Escapement	29,970	60,782	47,797	84,926	11,983	15,250	17,392	9,511	12,743	25,212
Grays Harbor	Pre-Season	20,238	35,773	66,312	45,352	38,038	29,370	12,000	9,903	17,665	18,492
	Post-Season	27,238	66,317	49,784	34,274	20,596	15,786	12,136	8,879	19,776	43,582
	Escapement	26,193	57,526	38,813	17,494	13,483	11,268	11,342	6,249	15,216	34,644
Strait of Juan de Fuca	Pre-Season	1,841	1,761	2,494	2,438	3,460	3,830	2,143	2,745	2,587	2,222
	Post-Season	1,737	4,892	1,178	3,233	2,382	1,567	769	841	1,462	1,849
	Escapement	1,562	4,603	1,071	2,739	2,034	1,313	503	454	1,305	1,343
Nooksack/ Samish	Pre-Season	82,431	171,000	81,921	78,484	126,869	135,100	19,414	130,070	69,145	61,827
	Post-Season	133,200	109,641	133,680	89,901	67,657	66,610	48,631	27,471	32,007	48,895
	Escapement	75,919	86,284	112,682	53,563	47,644	29,289	21,571	16,257	26,267	30,509
Skagit	Pre-Season	45,875	304,049	52,410	109,715	25,695	164,094	90,481	132,036	26,828	50,226
	Post-Season	97,045	406,578	37,217	171,200	53,672	213,490	37,627	29,946	29,479	46,149
	Escapement	73,175	210,028	18,017	150,196	34,600	105,239	19,576	22,552	26,744	39,911
Stillaguamish/ Snohomish	Pre-Season	113,600	685,100	245,246	264,542	225,113	445,800	287,993	229,251	92,477	90,660
	Post-Season	361,843	691,377	214,609	382,872	84,791	479,987	235,799	125,064	37,689	109,358
	Escapement	85,119	377,481	172,354	212,463	38,788	272,925	43,664	38,553	29,378	46,628
South Puget Sound	Pre-Season	363,090	241,500	448,365	470,048	655,742	466,700	408,040	686,511	348,333	650,986
	Post-Season	972,934	970,442	742,940	1,022,749	414,939	939,638	1,036,774	464,193	344,854	623,197
	Escapement	313,570	320,721	316,816	356,712	137,442	369,035	369,455	152,579	150,887	201,992
Hood Canal	Pre-Season	353,949	446,616	342,061	501,100	749,593	668,400	587,155	668,397	374,929	477,409
	Post-Season	802,605	893,288	1,183,289	1,173,077	356,243	745,675	676,602	553,122	446,476	416,461
	Escapement	257,770	368,464	331,378	229,893	100,242	185,875	162,425	72,012	55,879	49,484

Table 4-3. Washington winter Chum salmon pre- and post-season estimates of run size and estimated spawning escapements, 2001–2010.

Region	Type	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
South Puget Sound	Pre-Season	54,631	11,700	34,575	76,464	142,406	149,200	81,065	98,922	83,380	89,293
	Post-Season	163,610	237,635	53,112	134,002	72,730	75,833	105,933	89,271	35,544	102,235
	Escapement	139,046	206,469	49,050	98,580	43,908	58,786	73,442	45,162	15,486	79,550

time period in Boundary Area fisheries (Appendix A). The boundary areas for Washington are U.S. catch Areas 4B, 5, 6C in the Strait of Juan de Fuca (SJF), and Areas 7, 7A in the San Juan Islands (SJI) and Point Roberts (PR) areas. Table 4-4 provides Chum salmon harvest during this summer Chum salmon accounting period for these U.S. Boundary Area fisheries.

Table 4-4. Harvest of Chum salmon in the SJF and the SJI/PR commercial fisheries during the summer Chum salmon accounting period, July 1–September 15, 2001–2010.

Year	Time Period [1]						Yearly Total
	7/1–8/8	8/9–8/15	8/16–8/22	8/23–8/29	8/30–9/5	9/6–9/15	
2001	25	0	0	0	0	0	25
2002	38	11	0	0	0	8	57
2003	179	102	123	4	0	12	420
2004	139	25	0	15	31	25	235
2005	9	13	10	31	14	104	181
2006	12	54	75	25	3	30	199
2007	34	5	0	0	0	9	48
2008	240	0	1	0	0	29	270
2009	13	0	0	0	5	69	87
2010	27	4	91	118	54	31	325
Averages	72	21	30	19	11	32	185

(1) Time Period notation is month/day (e.g. 7/1-8/8 refers to July 1 to August 8).

Table 4-5. Harvest of summer, fall, and winter Chum salmon in SJF, SJI/PR, Puget Sound and Washington coastal areas, 2001–2010 [1].

Year	Region			
	SJF (Areas 4B, 5, 6C)	SJI/PR (Areas 7, 7A)	Puget Sound [2]	WA Coast [3]
2001	10,400	3,281	1,581,793	26,892
2002	1,818	111,864	1,769,675	42,861
2003	516	84,190	1,389,178	50,750
2004	5,384	166,466	2,075,556	48,737
2005	2,086	77,606	668,181	24,216
2006	4,751	109,223	1,596,074	13,779
2007	6,998	27,397	1,452,669	2,707
2008	6,083	75,719	962,701	7,080
2009	905	24,348	637,798	10,410
2010	1,844	23,617	961,131	12,509
Averages	4,079	70,371	1,309,476	23,994

(1) Includes recreational harvest: 2010 harvest estimates are preliminary.
(2) All other Puget Sound freshwater and marine harvest areas except SJF or SJI/PR fisheries.
(3) WA Coast combines harvest from Areas 1–4 including Grays Harbor, Willapa Bay, Columbia River and Coastal Rivers.

Table 4-5 provides total Chum salmon harvest information from the SJF fisheries in Areas 4B, 5, and 6C and the SJI/PR fisheries in Areas 7 and 7A. Table 4-5 also includes annual Chum salmon harvest totals for the Puget Sound and the Washington Coastal areas.

4.2 United States Strait of Juan de Fuca Fisheries (Areas 4B, 5, 6C)

4.2.1 Management Intent

During the 2010 season the management strategy for the Strait of Juan de Fuca fishery consisted of limiting the total effort in this fishery and basing management decisions on the needs of Puget Sound stocks of Chum salmon. The regime of this fishery has been maintained by limiting access to four Treaty Indian Tribes using only gill net gear.

This fishery has been constrained by low catch rates, low market prices, and inclement weather conditions, resulting in relatively modest harvest levels over the period of 2001–2010 (Table 4-5). The harvest in 2010 had a modest increase from the 2009 level. Harvest and effort for the 2001–2010 period was well below levels observed in the late 1980s and early 1990s.

4.2.2 Fishery Description

The fall Chum salmon fishery opened the week of October 10, 2010 with a schedule of three days per week and continued through November 13, 2010. As in previous years, the fishery in Areas 4B, 5 and 6C was restricted to Treaty Indian fishers using gill nets. A total of 1,484 Chum salmon was harvested in this Treaty Indian fishery. An additional 46 Chum salmon were harvested in recreational fisheries, resulting in a total harvest estimate of 1,530 Chum salmon for the Chum salmon-directed management period.

Incidental harvests of Chum salmon prior to the Chum salmon-directed fishing season increased slightly in 2010 relative to 2009, primarily due to the unusually extensive Sockeye salmon fishery during the passage of summer Chum salmon, and the early portion of the fall run which overlaps the Coho salmon season (Table 4-5). A total of 174 Chum salmon, including those harvested in SJF test fisheries, were recorded through September 15, 2010. Two of these 174 were caught incidentally during a troll fishery in May. The remaining 172 were all reported during the summer Chum accounting period (July 1 – September 15). During the subsequent Coho salmon-directed fishery, an additional 140 Chum salmon were harvested.

The total annual harvest for the Strait of Juan de Fuca in 2010 was 1,844 Chum salmon (Table 4-5).

4.3 San Juan Islands / Point Roberts Fisheries (Areas 7 and 7A)

4.3.1 Management Intent

Chum salmon fisheries in Areas 7 and 7A are regulated to comply with a base harvest ceiling of 130,000 Chum salmon, unless a critically low level of abundance (< 1,000,000) is identified for

those populations migrating through Johnstone Strait (Inside Chum salmon). Chapter 6, Annex IV, specifies that Chum salmon-directed fishing is not allowed in Areas 7 and 7A before October 10. Paragraph 10 (a-b) specifies that for run sizes below the critical threshold, harvest of Chum salmon in Areas 7 and 7A will be limited to those taken incidentally to other species and in other minor fisheries, and shall not exceed 20,000.

On October 7, 2010, based on Inside area test fishery catches, Canada indicated that an in-season update of return abundance of the Inside area Chum salmon was at a critical level. Therefore, no commercial fisheries were opened as planned on October 10.

Paragraph 10 (d) says that if Canada provides an estimate of Fraser River run sizes below 900,000, the U.S. will limit its fishery impacts to not exceed harvest of 20,000 Chum salmon from the day following notification. An initial in-season Fraser Chum salmon run size abundance estimate of 1.098 million was provided to the U.S. on October 15, 2010 allowing the U.S. to initiate commercial fishing. The Treaty Indian gill net and purse seine fisheries were opened on October 16, 2010 and ran continuously through October 22, 2010. The Non-Treaty gill net and purse seine fleets were open daily from October 18, 2010 through October 22, 2010. Harvests per vessel and effort were low throughout the fishery.

An additional update of the estimated Fraser Chum salmon run size was provided by Canada on October 18, with a decreased estimate of 810,000, triggering the limit of 20,000 additional Chum salmon to be harvested in Areas 7 and 7A beginning October 19, 2010.

The U.S. Chum salmon fishery was monitored closely after that point to ensure that the 20,000 fish limit was not exceeded. The fishery was closed for both Treaty Indian and Non-Indian fishers at 11:59 PM on October 22, 2010. The U.S. harvest between October 19 and 22, 2010 in Areas 7 and 7A was 8,657 Chum salmon. There was an additional run size update communicated from Canada on Thursday October 28, 2010 for a Fraser River Chum salmon run size of 799,000.

4.3.2 Fishery Description

Non-Indian reef net fisheries targeting adipose fin-marked Coho salmon were conducted from the end of Fraser Panel control (September 18), until October 7, 2010. Chum salmon retention was prohibited in this fishery until October 1, 2010. Chum salmon harvest in this fishery, between October 1, 2010 and October 7, 2010 was 1,089 fish. Reef nets opened daily targeting Chum salmon from October 16, 2010 through October 22, 2010 harvesting an additional 61 Chum salmon, for a total of 1,150 Chum salmon harvested in the reef net fishery.

There were 153 incidentally harvested Chum salmon reported for Areas 7 and 7A prior to September 16, 2010. The total 2010 Chum salmon harvest by all gears in Areas 7 and 7A, was 23,617 (Table 4-5). Harvest distribution, between Areas 7 and 7A was 85.7% and 14.3%, respectively.

During the fall Chum salmon-directed fisheries in Areas 7 and 7A, there was a reported bycatch of 1,823 Coho salmon and one Steelhead.

5 STOCK IDENTIFICATION

5.1 Tagging of Adult Chum Salmon

No adult tagging projects were reported by either Canada or the United States in marine or nearshore areas in 2010.

5.2 Otolith, Fin Marking and Coded Wire Tagging (CWT)

5.2.1 Canada

Thermal marking of otoliths (Volk *et al.* 1987) has been used as a technique of mass marking hatchery raised salmonids in B.C. since the early 1990's (Hargreaves *et al.* 2001). The method involves manipulating the temperature of the rearing water by at least 2°C to induce a mark on the otolith. The change in water temperature can be accomplished through the use of two different water sources, through heating or chilling the water. By altering water temperature over a period of time, unique banding patterns (i.e. a "mark") can be created.

Thermal marking was first used on Chum salmon at Nitinat Hatchery on the West Coast of Vancouver Island in 1993 and continues to be used as a means of estimating hatchery contribution to both fisheries and escapement. Thermal marking is currently the only mark being applied to Chum salmon from Nitinat hatchery (Table 5-1). Transplanting thermally-marked Chum salmon into Klanawa River started with the 2001 brood and ended with the 2006 brood year (Table 5-1).

Table 5-1. Releases of Chum salmon with thermally-marked otoliths from WCVI based Canadian hatchery facilities, 2001–2010.

Brood Year	Nitinat Hatchery Release Sites		Conuma Hatchery Release Sites					
	Nitinat River & Lake	Klanawa River	Conuma River	Conuma Estuary	Tlupana River	Sucowa River	Canton River	Deserted River
2001	27,093,836	3,162,846	569,118	1,649,290	390,754	200,803	1,070,539	272,395
2002	22,757,842	2,915,502	-	1,792,758	1,038,542	445,007	892,140	341,635
2003	21,252,421	2,516,338	-	1,585,534	425,261	410,872	484,570	798,330
2004	32,684,608	2,631,539	-	1,882,230	932,556	1,023,658	679,554	-
2005	36,724,205	2,739,742	-	914,381	744,834	256,296	434,449	-
2006	26,323,943	2,585,428	-	1,455,119	1,139,028	181,333	133,731	-
2007	13,004,189	-	-	271,820	109,922	15,701	47,846	-
2008	7,631,058	-	-	1,011,562	254,905	292,430	418,655	-
2009	5,252,749	-	-	1,833,322	685,465	551,365	854,548	-
2010	14,182,582	-	-	1,794,205	1,015,355	311,828	646,203	-

A second hatchery on the West Coast of Vancouver Island, Conuma Hatchery, first began thermally marking otoliths for several populations of Chum salmon beginning with the 1998 broodyear. This continued in 2010 with extensive releases of thermally-marked otolith Chum salmon in various river systems of Nootka Sound (Table 5-1). Similar to Nitinat releases, comprehensive adult sampling programs aimed at detecting (i.e. recapturing) the thermally-marked Chum salmon have occurred during the fall Chum salmon fisheries. Information from these programs has permitted a better understanding of timing and catch distribution for the Chum salmon populations in Nootka Sound.

Table 5-2. Releases of marked Chum salmon from southern B.C. based Canadian hatchery facilities, 2001–2010.

Population	Broodyear	Fin Clip Type [1]	Clipped	Poor Clips + Unclipped	Total
Big Qualicum River	2001	ADRV	245,794	8,596	254,390
	2002	ADRV	252,260	10,359	262,619
	2003	ADRV	251,939	4,856	256,795
	2004	ADRV	261,366	6,579	267,945
	2005	ADRV	252,585	9,775	262,360
	2006	ADRV	252,016	6,853	258,869
	2007	ADRV	251,329	9,471	260,800
	2008	ADRV	204,801	5,409	210,210
	2009	ADRV	250,692	8,381	259,073
	2010	ADRV	201,825	5,463	207,288
Conuma River	2001	ADLV	102,059	4,018	106,077
Little Qualicum River	2001	ADLV	266,330	7,874	274,204
	2002	ADLV	249,887	120	250,007
Salloomt River	2001	LV	97,015	4,595	101,610
	2002	LV	100,637	4,742	105,379
	2003	LV	103,148	1,054	104,202
Theodosia River	2002	LV	101,029	0	101,029
Sucwoa River	2001	LV	76,516	0	76,516
Sugsaw Creek	2001	LV	31,000	0	31,000
	2002	LV	11,000	0	11,000
	2003	LV	11,000	0	11,000
	2004	LV	20,600	0	20,600

(1) Clip Types: AD-adipose fin; LV-left ventral fin; RV-right ventral fin.

Not all release groups were represented by a mark. Contributions to fisheries and escapement for those groups were estimated by associating them with a marked release group having a similar size and release timing. Table 5-2 provides a summary of mark/tag combinations applied from 2001–2010 brood years. Big Qualicum River is the only population that had any fin-clipped Chum salmon releases in 2010 (Table 5-2).

Additionally, determining the contribution of Chum salmon from hatchery facilities can be based on externally marking a portion of the fry releases with a fin clip (e.g. adipose fin clip) in combination with the application of an internal coded-wire tag, and the subsequent recovery of these mark/tag combinations in commercial fisheries and escapement programs. However, in the last 10 years, only Inch Hatchery has released any Chum salmon with a CWT (Table 5-3).

Table 5-3. Releases of CWT (coded-wire tag) Chum salmon and the associated unclipped releases, from southern B.C. based Canadian hatchery facilities, 2001–2010.

Brood Year	Hatchery Release Sites							
	Inch Creek (Fraser River)				Sliammon River (Southern mainland)			
	Adipose clip + CWT	Adipose clip only	Unclipped	Total	Adipose clip + CWT	Adipose clip only	Unclipped	Total
2001	49,931	100	1,124,599	1,174,630	0	0	0	0

5.2.2 United States

Otolith marking (Volk *et al.* 1987) was used in several other hatchery supplementation and re-introduction programs for summer Chum salmon in the Hood Canal and Strait of Juan de Fuca regions (Table 5-4), and fall Chum salmon in Puget Sound and the Lower Columbia River (Table 5-5). Otolith marking was a tool for assessing program success and determining proportions of hatchery- and natural-origin fish (and identifying hatchery strays) on spawning grounds. Supplementation summer Chum salmon releases for recovery and reintroduction ended at Discovery, Chimacum, and Union with brood year 2003.

Table 5-4. Numbers of Hood Canal summer Chum salmon released with thermally-marked otoliths or an adipose fin clip by brood year, 2002–2010.

Brood Year	Hood Canal Summer Chum Salmon								
	Jimmy comelately	Discovery Bay [1]	Chimacum [1]	Big Beef	Big Quilcene [2]	Hamma Hamma	Lilliwaup	Union [1]	Tahuya
2002	20,887	118,347	57,300	72,622	272,017	61,000	96,000	82,636	-
2003	50,307	88,610	57,435	76,353	92,559	75,356	103,913	35,343	-
2004	76,982	-	-	14,814	-	57,000	99,500	-	118,872
2005	57,300	-	-	-	-	117,837	106,466	-	119,260
2006	79,428	-	-	-	-	151,550	88,800	-	133,826
2007	73,840	-	-	-	-	48,530	0	-	53,632
2008	88,766	-	-	-	-	208,450	68,810	-	97,142
2009	92,200	-	-	-	-	-	140,210	-	69,711
2010	107,000	-	-	-	-	-	138,000	-	130,000

(1) Salmon and Snow creek is Discovery Bay combined, program discontinued after brood year 2003.
(2) Adipose fin clipped only; no thermally-marked otoliths.

A summer Chum salmon supplementation program was started in 1992 at the Quilcene National Fish Hatchery to address severe declines in the numbers of summer Chum salmon returning to the Quilcene River and Hood Canal. In recent years, an adipose fin clip (with no CWT) was utilized to aid in identifying hatchery fish for terminal fisheries management and project evaluation purposes. Brood year 2003 was the final year summer Chum salmon were marked and released from Quilcene National Fish Hatchery (Table 5-4).

Table 5-5. Numbers of Puget Sound and Lower Columbia River fall Chum salmon released with thermally-marked otoliths or an adipose fin clip by brood year, 2002–2010.

Brood Year	Puget Sound Fall Chum Salmon	Lower Columbia River Fall Chum Salmon		
	Whatcom Creek	Grays River Hatchery	Sea Resources Hatchery	Washougal Hatchery
2002	-	398,000	84,818	218,283
2003	-	357,000	102,132	75,952
2004	-	163,000	-	-
2005	-	155,501	-	19,578
2006	-	129,427	-	-
2007	450,000	77,609	-	-
2008	400,000	104,600	-	-
2009	-	300,000	-	70,000
2010	1,263,000	236,527 [1]	-	57,455

(1) Includes Grays River brood stock released in Big Creek, OR.

5.3 Genetic Stock Identification

In 2010, the Committee completed a joint recommendation to the Southern Panel concerning the type of stock identification methodology to be used for immediate and future application of Canada and United States (U.S.) Chum salmon stock assessment (Appendix C). The Pacific Salmon Treaty (Annex IV, Chapter 6, Section 2) states:

> *"When the Parties provide stock composition information for fisheries, the Committee shall evaluate and report its conclusions using bilaterally agreed upon methods."*

Fisheries of interest include Johnstone Strait, Qualicum, Fraser River, and Nitinat in Canada and Point Roberts, San Juan Islands and the Strait of Juan de Fuca in the U.S.

5.3.1 Fishery Sample Collection for Genetic Stock Identification

5.3.1.1 Canada

GSI samples were collected during the Johnstone Straits purse seine fisheries (commercial and test fishery) in 2010 (Table 5-6).

Table 5-6. Chum salmon tissue samples collected in Johnstone Strait fisheries and analyzed for GSI, 2001–2010.

Year	Commercial Samples		Test Fishery Samples	
	Collected	Analyzed	Collected	Analyzed
2001	300	300	0	0
2002	0	0	0	0
2003	600	600	0	0
2004	600	600	0	0
2005	0	0	0	0
2006	716	714	0	0
2007	879	869	0	0
2008	995	868	830	449
2009	1,418	1,101	999	0
2010	400	400	1,015	1,114

5.3.1.2 United States

Among focused studies, WDFW continued its use of GSI techniques to distinguish supplementation-origin from natural-origin adult summer Chum salmon in Hood Canal. In particular, mSAT DNA data were used to clarify uncertain hatchery assignments generated from broken otoliths or ambiguous otolith thermal marks. For instance, in 2006–2009, WDFW used genetic techniques to clarify otolith marking data in the monitoring of Hood Canal summer Chum salmon supplementation projects. All returning supplementation origin summer Chum salmon were otolith marked, but some otoliths broke and there was ambiguity between thermal marks for some programs, meaning that fish could be identified as supplementation or natural origin, but not identified to their program of origin. These fish were genotyped and assigned to collection in the Hood Canal summer Chum salmon genetic baseline to identify fish to the program of origin. WDFW also conducted juvenile stock assignment studies in the Strait of Juan de Fuca and Hood Canal during 2009 and 2010. These studies documented emigration timing and relative production patterns of summer and fall Chum salmon in key populations.

Additionally, 600 tissue samples were collected near Apple Cove Point in Puget Sound Area 9, 200 on October 27, 2010, 200 on November 3, 2010 and 200 on November 10, 2010 as the fifth year of Chum salmon DNA collection from this test fishery.

No Chum salmon DNA samples were collected in 2010 for stock identification purposes during the Chum salmon-directed commercial fisheries occurring Areas 7 and 7A.

5.3.2 Baseline Collection for Genetic Stock Identification.

5.3.2.2 Canada

In 2010, CDFO continued to collect baseline GSI tissue samples of Southern British Columbia Chum salmon populations (Table 5-7).

Table 5-7. Fall Chum salmon GSI tissue collections from Southern B.C. by Conservation Unit, collection site, life stage, and influence [1] of enhancement, 2010.

Conservation Unit	Collection Site	Life Stage	Enhancement Level [1]	Sample Size
Southwest Vancouver Island	Bedwell River	adult	natural	70
Southwest Vancouver Island	Black Creek (WCVI)	adult	natural	25
Southwest Vancouver Island	Brodick Creek	adult	natural	8
Southwest Vancouver Island	Canton River	adult	mixed	48
Southwest Vancouver Island	Chum Creek	adult	natural	4
Southwest Vancouver Island	Cypre River	adult	natural	10
Southwest Vancouver Island	Deserted Creek	adult	natural	13
Southwest Vancouver Island	Espinosa Creek	adult	natural	17
Southwest Vancouver Island	Hammond Creek	adult	natural	9
Southwest Vancouver Island	Hoiss Creek	adult	natural	27
Southwest Vancouver Island	Kaouk River	adult	natural	55
Southwest Vancouver Island	Little Toquart	adult	natural	76
Southwest Vancouver Island	Little Zeballos	adult	natural	19
Southwest Vancouver Island	Lord Creek	adult	natural	29
Southwest Vancouver Island	Marvinis Bay Creek	adult	natural	3
Southwest Vancouver Island	Nitinat River	adult	mixed	123
Southwest Vancouver Island	Owissitsa Creek	adult	natural	12
Southwest Vancouver Island	Parks River	adult	natural	26
Southwest Vancouver Island	Salmon Creek	adult	natural	52
Southwest Vancouver Island	Sucwoa River	adult	natural	48
Southwest Vancouver Island	Tranquil Creek	adult	natural	80
Southwest Vancouver Island	Tsowwin River	adult	natural	19
Southwest Vancouver Island	Warne Bay falk	adult	natural	58
Southwest Vancouver Island	Zeballos River	adult	natural	9

Note: Table 5-7 is continued on the next page.

Table 5-7. Continued.

Conservation Unit	Collection Site	Life Stage	Enhancement Level [1]	Sample Size
Northeast Vancouver Island	Nimpkish River	adult	mixed	160
Georgia Strait	Myrtle Creek	adult	mixed	3
Georgia Strait	Snake Bay Creek	adult	natural	98
Georgia Strait	Big Qualicum River	adult	mixed	292
Georgia Strait	Cowichan River	adult	mixed	144
Georgia Strait	Englishman River	adult	mixed	34
Georgia Strait	Little Qualicum	adult	mixed	160
Georgia Strait	Nanaimo River	adult	mixed	191
Georgia Strait	Puntledge River	adult	mixed	200
Lower Fraser	Blaney Creek	adult	mixed	19
Lower Fraser	Hicks Creek	adult	natural	16
Lower Fraser	Hopedale Slough	adult	natural	56
Lower Fraser	Kanaka Creek	adult	mixed	18
Lower Fraser	MacIntyre River	adult	natural	5
Lower Fraser	Peach Creek	adult	natural	122
Lower Fraser	Siddle Creek	adult	natural	2
Lower Fraser	Silverdale Creek	adult	natural	20
Lower Fraser	Squawkum Creek	adult	natural	129
Lower Fraser	Street Creek	adult	natural	34
Lower Fraser	Widgeon Slough	adult	natural	22
Lower Fraser	Worth Creek	adult	mixed	91
Fraser Canyon	Kawkawa Creek	adult	natural	12
Total				2,680

(1) Enhancement level refers to the degree to which the CDFO Committee members believed hatchery production contributed to the returns to the collection site. Based partly on the enhancement history in the CDFO hatchery production database, enhancement level is subjectively classified as either *hatchery* (insignificant contribution of natural production to returns), *mixed* (both enhanced and natural production contribute significantly to returns) or *natural* (insignificant contribution of hatchery production to returns).

5.3.2.1 United States

During 2010, WDFW and Washington Treaty Tribes continued its baseline sampling of Washington State populations of Chum salmon (Table 5-8). Fin tissues were stored for future analyses of DNA-based genetic variation.

Table 5-8. Summer, fall and winter Chum salmon GSI tissue collections from WA State, 2010.

Code	Collection Site / Run group / Locality	Enhancement Level [1]	Sample Size
10HV	Jimmycomelately Creek summer	mixed	105
10HY	Chimacum Creek summer	mixed	37
10HZ	Little Quilcene River summer	mixed	57
10IA	Big Quilcene River summer	mixed	73
10IC	Duckabush River summer	mixed	61
10ID	Hamma Hamma River summer	mixed	58
10IE	Lilliwaup Creek summer	mixed	168
10IG	Union River summer	mixed	113
10LB	Grays River fall	hatchery	287
10LH	Hoodsport Hatchery fall	hatchery	100
10LI	McKernan Hatchery fall	hatchery	100
10LK	Beebe Creek - Dungeness River fall	natural	114
10LL	Spencer Creek - Hood Canal fall	natural	51
10LM	Big Mission Creek - Hood Canal fall	natural	40
10LN	Dewatto River - Hood Canal fall	natural	47
10LP	Hamma Hamma River - Hood Canal fall	natural	78
10LR	Upper Skagit River - fall [2]	natural	50
10LS	Sauk River - fall [2]	natural	69
10LY	Big Beef Creek - fall	natural	78
10LZ	Lilliwaup Creek - fall [2]	natural	100
10LT	North Fork Nooksack River - Kendall Slough [2]	mixed	100
10MG	Kennedy Creek - fall south Puget Sound [2]	natural	59
10MH	Skookum Creek - fall south Puget Sound [2]	natural	69
10MD	Mill Creek-fall south Puget Sound [2]	natural	36
10MW	Nisqually-winter	natural	80
10MA	Grovers Creek - fall [2]	natural	48
10MC	Chico Creek - fall [2]	natural	14
10HL	Cowlitz River	natural	6
10PC	Stillaguamish River-fall [2]	natural	121
10BP	Skykomish River-fall [2]	natural	170
10PD,10PE	Tulalip Hatchery/Coho Creek-fall [2]	hatchery	123
09LC	North Fork Nooksack River - Kendall Slough [2]	mixed	8
09LA	Whatcom Independent Tributary - Whitehall Creek	natural	50
09KY	Whatcom Independent Tributary - Chuckanut Creek	natural	45
09KZ	Whatcom Independent Tributary - Oyster Creek	natural	38
Total			2,754

(1) Enhancement level refers to the degree to which the U.S. Committee members believed hatchery production contributed to the returns to the collection site. Based partly on the enhancement history, enhancement level is subjectively classified as either *hatchery* (insignificant contribution of natural production to returns), *mixed* (both enhanced and natural production contribute significantly to returns) or *natural* (insignificant contribution of hatchery production to returns).

(2) These tissues were collected to address the mSAT and SNP baseline expansion effort requested by the Committee in addition to normal program collections.

REFERENCES CITED

CHUMTC [Chum Technical Committee]. 2011. 2009 Post Season Summary Report. Pacific Salmon Commission, Report TCCHUM (11)-1. Vancouver, British Columbia.

CDFO [Canadian Department of Fisheries and Oceans]. 2010. Pacific Region Integrated Fisheries Management Plan, Salmon, Southern B.C., June 1, 2010 to May 31, 2011. Fisheries Management Branch, Fisheries and Oceans Canada. Vancouver, British Columbia.

Gazey, W.J. and R.V. Palermo. 2000. A preliminary review of a new model based on test fishing data analysis to measure abundance of returning Chum stocks to the Fraser River. DFO Canadian Stock Assessment Secretariat Research Document 2000/159. 30 p.

Hargreaves, B., W. Luedke, and J, Till. 2001. Application of otolith thermal mass marking in British Columbia, Canada. NPAFC Technical Report No. 3. 2001 International Workshop on Salmonid Otolith Marking. March 21, 2001, Seattle, WA, U.S.A.

Ryall, P., C. Murray, V. Palermo, D. Bailey, and D. Chen. 1999. Status of clockwork Chum salmon stock and review of the Clockwork Management Strategy. DFO Canadian Stock Assessment Secretariat Research Document 99/169. 134 pp.

Volk, E.C., Schroder, S.L., and Fresh, K.L. 1987. Inducement of banding patterns on the otoliths of juvenile chum salmon (Oncorhynchus keta). Proceedings of the 1987 northeast Pacific pink and chum salmon workshop. Alaska Department of Fish and Game: 206–212.

APPENDICES

Appendix A. Annex IV, Chapter 6, of the Pacific Salmon Treaty.

ANNEX IV, CHAPTER 6, OF THE PACIFIC SALMON TREATY

Southern British Columbia and Washington State Chum Salmon

The provisions of this Chapter shall apply for the period 2010 through 2018.

1. The Parties shall maintain a Joint Chum Technical Committee ("the Committee") reporting, unless otherwise agreed, to the Southern Panel and the Commission. The Committee will undertake to, *inter alia*:

    a) maintain and present historical catch and escapement information for stocks relevant to the Treaty;

    b) utilize available information to estimate and document stock composition and exploitation rates in fisheries of concern to the Treaty;

    c) review annually the Parties' assessment of stock status and fisheries activities for Chum fisheries of concern to the Treaty;

    d) identify high priority research and information needs for the Parties, including fishery and escapement monitoring and assessment, stock identification, and enhancement; and

    e) periodically and/or when requested;

        i. Exchange available information on the productivity and escapement requirements of stocks relevant to the treaty;

        ii. Identify and document stocks of concern (with respect to conservation) relevant to the treaty;

        iii. Evaluate the effectiveness and performance of management strategies; and

        iv. Evaluate the effectiveness of alternative regulatory and production strategies recommended by the Parties.

2. When the Parties provide stock composition information for fisheries, the Committee shall evaluate and report its conclusions using bilaterally agreed upon methods.

3. Canada and the United States shall assess catch levels and make attempts to collect additional genetic samples from any Chum salmon caught during the July 1 through September 15 time period in the Boundary Area fisheries (U.S. Areas 4B, 5, 6C, 7 and 7A; Canadian Areas 18, 19, 20, 21, and 29).

4. During the period from July 1 through September 15, Canada will require the live release of Chum salmon from all purse seine gear fishing in the Strait of Juan de Fuca (Canadian Area 20) and the United States will require the same for the non-Indian seine fisheries in

Areas 7 and 7A. Note: By U.S. regulation, purse seine fisheries are not permitted in U.S. Areas 4B, 5 and 6C.

5. Canada will manage its Johnstone Strait, Strait of Georgia, and Fraser River Chum salmon fisheries to provide continued rebuilding of depressed naturally spawning Chum salmon stocks, and, to the extent practicable, not increase interceptions of U.S. origin Chum salmon. Terminal fisheries conducted on specific stocks with identified surpluses will be managed to minimize interception of non-targeted stocks.

6. Canada will manage its Johnstone Strait mixed stock fishery as follows:

   a) Inside Southern Chum salmon levels of less than 1.0 million as estimated by Canada are defined, for purposes of this chapter, as critical;

   b) For run sizes above the critical threshold, Canada will conduct fisheries with an exploitation rate of up to 20% in Johnstone Strait of Inside Southern Chum salmon; and

   c) When run sizes are expected to be below the critical threshold, Canada will notify the United States and will only conduct assessment fisheries and non-commercial fisheries. Commercial fisheries targeting Chum salmon will be suspended.

7. Canada will manage its Fraser River fisheries for Chum salmon as follows:

   a) For Fraser River terminal area run sizes, identified in-season, at abundance levels lower than 900,000 Chum salmon, the Canadian commercial Chum salmon fisheries within the Fraser River and in associated marine areas (Area 29), will be suspended; and

   b) For Fraser River terminal area run sizes, identified in-season at levels greater than 900,000 Chum salmon, Canadian commercial Chum salmon fisheries within the Fraser River, shall be guided by the limits of the in-river Total Allowable Catch set by Canada.

8. Canada will manage the Nitinat gill net and purse seine fisheries for Chum salmon to minimize the harvest of non-targeted stocks.

9. Canada shall conduct a genetic sampling program of Chum salmon taken in the West Coast Vancouver Island troll fishery if early-season catch information indicates that catch totals for the July 1 through September 15 season may reach levels similar to 1985 and 1986. Sampling, should it occur, will include catches taken from the southern areas (Canadian Areas 121-124).

10. The United States will manage its Chum salmon fishery in Areas 7 and 7A as follows:

    a) Inside Southern Chum salmon levels of less than 1.0 million as estimated by Canada are defined, for purposes of this chapter, as critical;

    b) For run sizes below the critical threshold, the U.S. catch of Chum salmon in Areas 7 and 7A shall be limited to Chum salmon taken incidentally to other species and in other minor fisheries, but shall not exceed 20,000, provided that catches for the

purpose of genetic stock identification sampling shall not be included in the aforementioned limit;

c) For run sizes above the critical threshold, the base catch ceiling for the U.S. Chum salmon fisheries in Areas 7 and 7A will be 130,000 Chum salmon;

d) Canada will provide a run size estimate of Chum salmon entering the Fraser River no later than October 22. If the estimate is less than 900,000, the U.S. will limit its fishery impacts on Fraser River Chum salmon by restricting catch in Areas 7 and 7A to not exceed 20,000 additional Chum from the day following the date the U.S is notified. The total catch is not to exceed the catch ceiling of 130,000 Chum salmon;

e) U.S. commercial fisheries for fall Chum salmon in Areas 7 and 7A will not occur prior to October 10;

f) The U.S. will manage the Areas 7 and 7A fisheries for Chum salmon with the intent to minimize the harvest of non-targeted species;

g) No U.S. catch shortfalls may be accrued; however any overages shall be carried forward as indicated in (h) and (i);

h) Due to management imprecision, a catch in the U.S. of up to 135,000 Chum salmon will not result in an overage calculation. Catches in excess of 135,000 Chum salmon shall result in an overage being calculated by subtracting 130,000 from the total Chum catch. Overages will be accounted for by reducing the U.S. annual catch ceiling in up to two subsequent non-critical Inside Southern Chum salmon years; and

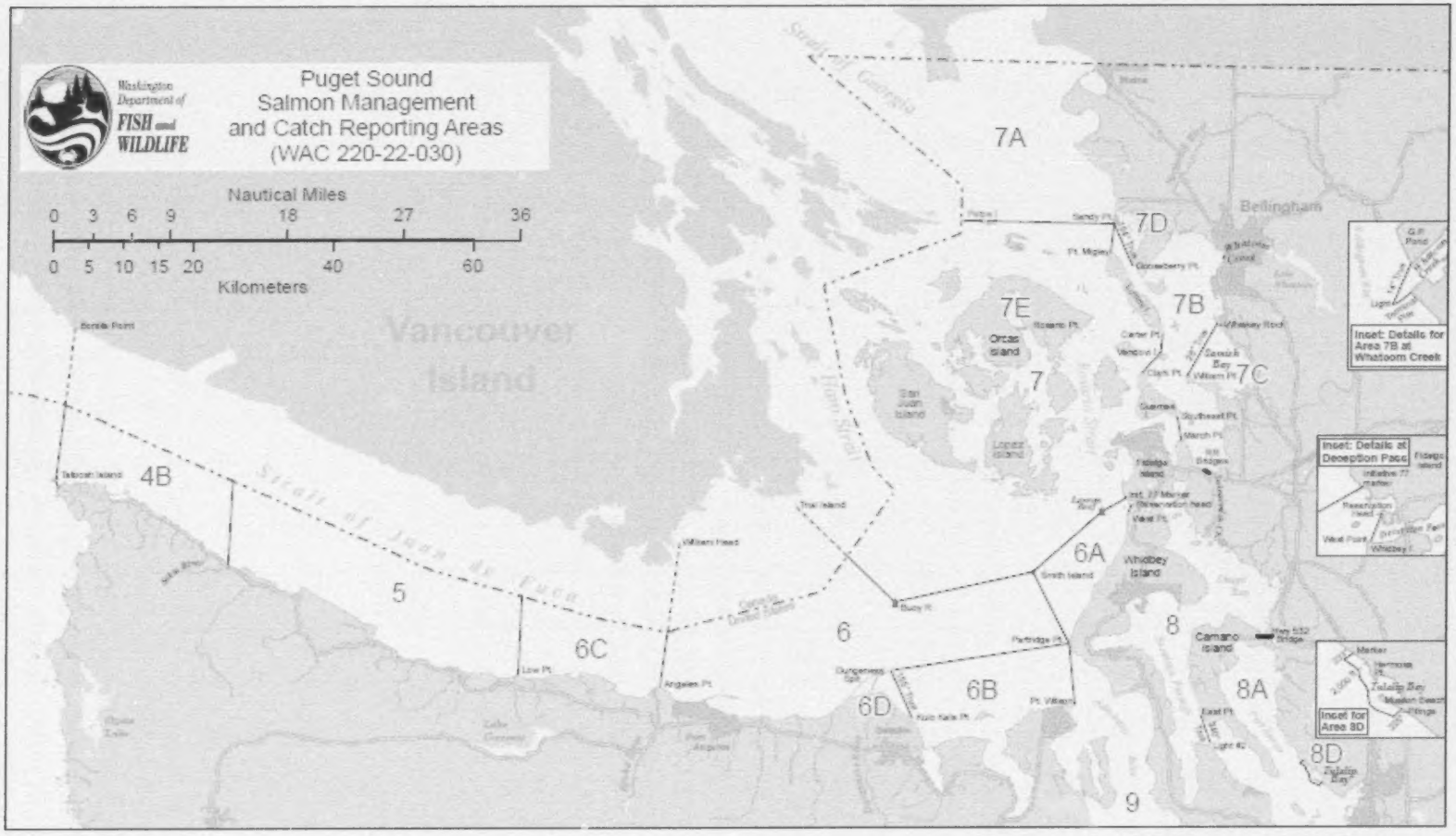
i) From the day following the date the U.S. is notified of a run size below the critical threshold as defined in 10(b) or (d), any catches in excess of 20,000 Chum salmon will result in an overage. Overages will be accounted for by reducing the U.S. annual catch ceilings in up to two subsequent non-critical Inside Southern Chum salmon years.

11. The United States shall conduct its Chum salmon fishery in the Strait of Juan de Fuca (United States Areas 4B, 5, and 6C) so as to maintain the limited effort nature of this fishery, and, to the extent practicable, not increase interceptions of Canadian origin Chum salmon. The United States shall continue to monitor this fishery to determine if recent catch levels indicate an increasing level of interception.

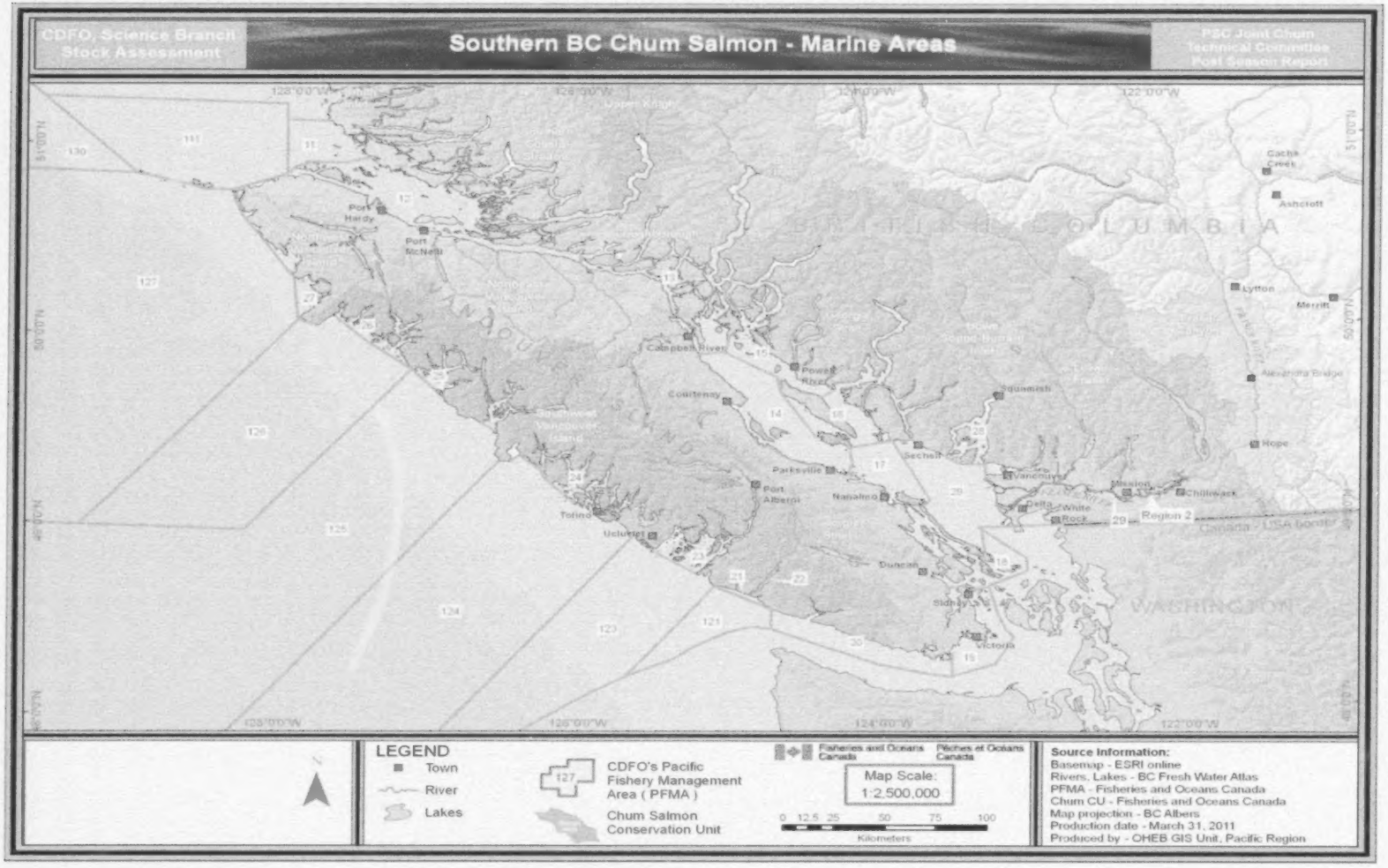
12. All information concerning by-catch of other salmon species from the Chum salmon fisheries covered by this chapter will be shared between the Parties in the annual Post Season Report.

13. Should circumstances arise that are inconsistent with either Parties understanding of the intent of the chapter, the Southern Panel will discuss the matter postseason and explore options for taking the appropriate corrective actions.

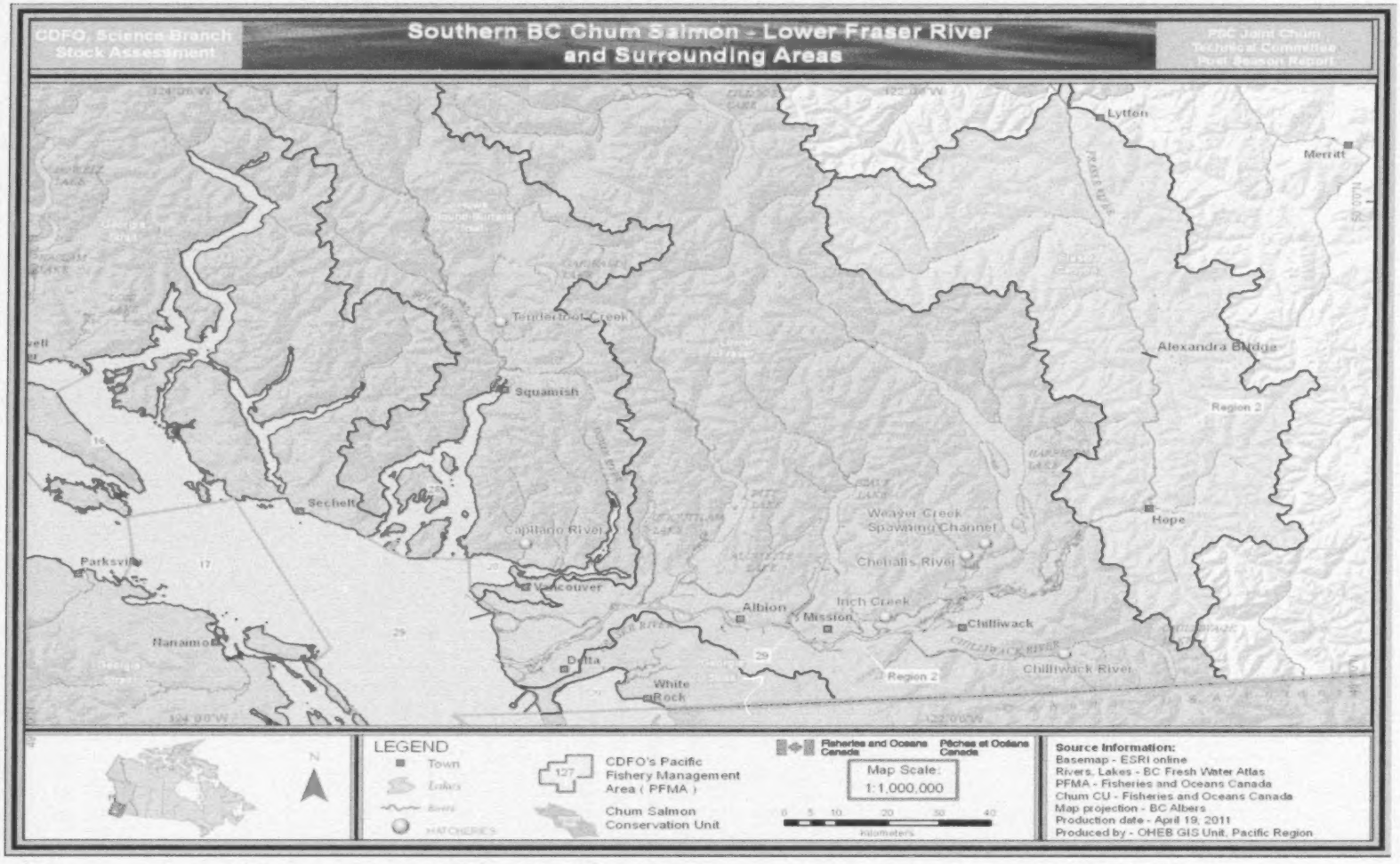
Appendix B-1. United States commercial salmon catch areas for the Strait of Juan de Fuca and Northern Puget Sound.



Appendix B-2. Canadian Pacific Fishery Management Areas (PFMA) for Southern B.C. - Marine areas.



Appendix B-3. Canadian Pacific Fishery Management Areas (PFMA) for Southern B.C. - Lower Fraser River and surrounding areas.



Appendix C. Joint direction paper presented to the PSC Southern Panel concerning the development of Chum salmon stock identification methodologies.

Joint Direction on Chum Salmon Stock Identification Methods

January 2010

Submitted by: Bilateral Chum Technical Committee

Goal

Provide a joint direction to the Southern Panel concerning the type of stock identification methodology to be used for immediate and future application of Canada and United States (U.S.) Chum stock assessment. Under the Pacific Salmon Treaty (Annex IV, Chapter 6, Section 2):

> *"When the Parties provide stock composition information for fisheries, the Committee shall evaluate and report its conclusions using bilaterally agreed upon methods."*

Fisheries of interest include Canadian fisheries (Johnstone Strait, Qualicum, Fraser River, Nitinat, and WCVI) and U.S. fisheries (Point Roberts, San Juan, Strait of Juan de Fuca and Washington Ocean).

Introduction

Historically, Canada and the U.S. have utilized a number of stock identification methodologies. There are two general types of marking, applied markers and natural markers. These have included:

Applied Markers

- Coded wire tags (CWT) – While successful for chinook and Coho, survival and returns of tagged Chum fry has been poor. This application is limited primarily to hatchery fish and extraction of the tag is lethal.
- Fin clips – Similar to CWT application, this is limited primarily to hatchery fish and can also reduce fry survival. Marking is constrained by the number of available fin clip combinations.
- Thermally induced otolith marks – This technique is currently used by numerous hatcheries in WCVI and in Puget Sound recovery supplementation programs. Limited to hatchery fish, sampling and processing is costly and otolith extraction is lethal. Although there are many possibilities, otolith marking is constrained by the number of available banding patterns.

Natural Markers

Genetic marks have been used for almost 30 years for the identification of Pacific salmon stocks. Once baselines are established for particular stocks, annual collections are not necessary because marker frequencies are relatively stable. Data for natural markers can be collected in both hatchery and wild stocks.

- Protein genetic markers (allozymes) – This technique was used in the 1980s and 90s to discriminate among Canadian / U.S. origin Chum stocks (Shaklee et al., 1990). Lethal sampling is often required for this method. No west coast laboratories are currently conducting allozyme analyses as this marker system has fallen out of widespread use in salmon assessment applications.
- DNA based markers – Are a widely accepted class of markers used to identify discrete salmon stocks. Sampling methods for both of the following techniques are non-lethal:
    i. Microsatellite markers (mSAT) – In the last 5 years, a mSAT baseline for Chum has been developed and is being used on a limited basis (Kirby, 2007); and
    ii. Single-nucleotide Polymorphisms (SNPs) – More recently, SNPs have been developed and evaluated for several species of Pacific salmon for stock separation (Smith et al., 2005; and Elfstrom et al., 2006). The State of Alaska is currently using a newly developed SNPs baseline to differentiate local and large aggregate stocks of Chum salmon.

mSAT versus SNPs

In comparing the DNA based techniques for Chum stock identification, the following factors are important:

- Potential for stock resolution: The Chum Chapter minimally requires stock separation of large aggregates (Fraser, Canadian Inside non-Fraser and Washington) in mixed stock samples. However, domestic and conservation needs in Canada and the U.S. require finer stock resolution. Generally both methods have been judged to be capable of delivering the minimal requirements. The potential for further stock resolution is currently under evaluation;
- Costs of processing samples: 2008 costs are approximately $22 to $43 per fish for ~15 mSAT markers (15 alleles/locus). Presently processing costs for SNPs are comparable but include 64 markers (2 alleles/locus). Laboratory automation should decrease costs of both methods;
- Standardization (repeatability between laboratories): mSAT analyses require some degree of subjective laboratory interpretation of DNA patterns. SNPs are objectively scored and results are therefore comparable among laboratories with minimal standardization;
- Processing time: Processing time for mSATs and SNPs is approximately the same. However, SNPs have a higher potential for automated processing and further reductions in analysis time;
- Levels of accuracy and precision: Based on a number of comparisons, accuracy and precision has been similar for mSAT and SNP (eg. Smith et al., 2007; Smith and Seeb, 2008); and

- Status of baselines: There is a standardized coast-wide mSAT baseline for chinook salmon (Seeb et al., 2007). Direction has been provided from the GSI Steering Committee and the Pacific Salmon Commission's Committee on Scientific Cooperation (PSC, 2008) to further develop SNP markers and evaluate their performance for separating Chinook stocks relative to mSATs. For Chum salmon, mSAT baseline development is largely complete for southern BC but inadequate for the Washington origin stocks. Currently there are SNP baseline data for Alaskan stocks and some Southern BC and Washington stocks.

Direction for Chum Salmon

Based on the extensive discussion within the bilateral Chum Technical Committee and geneticists from Alaska, Canada and Washington State, the Committee has agreed:

1) to use existing mSAT techniques for current* analyses;
2) to support further development of SNP technologies and the collection and evaluation of issue-specific baseline information for future** analyses; and,
3) to support the development of a standardized SNP coast-wide baseline.

*Short Term (Phase-in Period)

i. Stock identification of mixed stock fishery samples should continue to rely on the existing mSAT technology;
ii. When feasible, parallel analysis should be conducted on the mixed stock fishery samples, using the emerging SNP technology;
iii. Identify representative Chum stocks from Canada and U.S. based on size of stock, geographical area, run timing, stock "uniqueness", and fishery contribution. mSAT and/or SNP baseline data should be incorporated into a coast-wide baseline;
iv. Develop a standardized field sampling plan to collect the remaining tissues to complete the SNP baseline. Recently archived tissue samples could be incorporated into this SNP baseline;
v. Support the funding of research to improve the performance of the SNP baseline in mixed stock fisheries; and
vi. Support the funding of research to evaluate the comparability of the two technologies with respect to international, domestic, and conservation needs.

**Long Term

i. Support the expansion of adequate SNP markers to further Chum stock resolution capabilities for international, domestic, and conservation needs; and
ii. Support the maintenance of a dynamic and standardized coast-wide genetic baseline for Chum salmon.

References

Elfstrom, C.M., C.T. Smith, and J.E. Seeb. 2006. Thirty-two single nucleotide polymorphism markers for high-throughput genotyping of Sockeye salmon. Molecular Ecology Notes. Vol. 6, No. 4: 1255–1259.

Kirby, G. 2007. Southern Study Area Chum stock distribution assessment in Washington San Juan Islands—Pt. Roberts and in British Columbia Southern Gulf Fisheries. PSC Southern Boundary Restoration and Enhancement Fund Report. http://fund.psc.org/2007/Reports/SF_2007_I_1_Kirby.pdf

Pacific Salmon Commission. 2008. Recommendations for application of genetic stock identification (GSI) methods to management of ocean salmon fisheries: special report of the Genetic Stock Identification Steering Committee and the Pacific Salmon Commission's Committee on Scientific Cooperation. Pacific Salmon Comm. Tech. Rep. No. 23. 35 pp.

Seeb, L.W., A. Antonovich, M. Banks, T. Beacham, R. Bellinger, S. Blankenship, M. Campbell, N. Decovich, J.C. Garza, C. Guthrie, T. Lundrigan, P. Moran, S. Narum, J. Stephenson, J. Supernault, D. Teel, W. D. Templin, J. K. Wenburg, S. Young, and C.T. Smith. 2007. Development of a standardized DNA database for Chinook salmon. Fisheries. Vol. 32: 540–552.

Shaklee, J.B., S.R. Phelps, and J. Salini. 1990. Analysis of fish stock structure and mixed-stock fisheries by the electrophoretic characterization of allelic isozymes. *In:* Electrophoretic and Isoelectric Focusing Techniques in Fisheries Management, D.H. Whitmore (ed.). CRC Press. Pps. 173–196.

Smith, C.T., A. Antonovich, W.D. Templin, C.M. Elfstrom, and S.R. Narum. 2007. Impacts of marker class bias relative to locus-specific variability on population inferences in Chinook salmon: A comparison of single-nucleotide polymorphisms with short tandem repeats and allozymes. Transactions of the American Fisheries Society: Vol. 136, No. 6: 1674–1687.

Smith, C.T., J. Baker, L. Park, L.W. Seeb, C. Elfstrom, S. Abe and J.E. Seeb. 2005. Characterization of 13 single nucleotide polymorphism markers for Chum salmon. Molecular Ecology Notes: Vol. 5, No. 2: 259–262.

Smith, C.T., and L.W. Seeb. 2008. Number of alleles as a predictor of the relative assignment accuracy of STR and SNP baselines for Chum salmon. Transactions of the American Fisheries Society, No. 137: 751–762.

Appendix D. PSC Work Plan for the Joint Chum Technical Committee, 2010–2011.

PACIFIC SALMON COMMISSION WORK PLAN
2010-2011

Panel / Committee: Chum Technical Committee; Reporting to the Southern Panel

Date: October 20-21, 2010

Update on Bi-lateral Tasks Assigned Under Current PSC Agreement:

The committee completed the 2008 final report and submitted it to the PSC for publication in June 2010.

The Committee is in the process of drafting the final report on the 2009 fisheries. This report will be the main focus during the PSC meetings in January. Work on the 2010 report, given the availability of finalized information from the Parties, is expected to start in the fall of 2011, with the expectation that this report will be completed shortly after the PSC annual meeting in February, 2012

The committee's other focus for the 2010-2011 time period will be the completion of a revised draft of advice to the Southern Panel on Chum genetic baseline development. This includes:

- Complete a database of samples collected in southern BC and WA that are available for genetic analysis
- Develop a web-based map program that compliments the sample database to keep track of all samples and relevant metadata (e.g., adult run time, CU_ESU designation, processing laboratory, genetic data type, etc
- Determine necessary additional sampling to complete and/or update the existing baseline collections
- Estimate costs for above additional field sampling
- Estimate costs for lab analysis of existing samples
- Recommend a genetic approach or approaches for near- and far-term genetic analyses of chum salmon mixture problems
- Develop timeline and make assignments for completing advice before February 2011

There will also be time spent on possible Southern Endowment Fund opportunities and priorities for the next call for proposals. Also, the Committee will get an update on the ongoing joint SEF project on the assessment of stock composition of chum salmon caught in border area fisheries

Obstacles to Completing above Bi-lateral Tasks:

Note the Task and the issue preventing the completion the Task, along with recommendations, where appropriate, for how the Commission can remove these obstacles.

Reduced support for stock assessment and analysis, including escapement assessment, genetic sampling of Annex fisheries, and cohort survival assessment and productivity analysis, creates an impediment to completing the work prescribed in Annex IV, Chapter 6. This year's work plan

for the Chum Technical Committee will include a session to investigate options for meeting Treaty Obligations with the reduced programs.

Outline of Other Panel / Committee Tasks or Emerging Issues:

Highlight issues that have significance to the Treaty and that may have to be considered by this Panel/Committee in future work plans.

NONE

Potential Issues for Commissioners:

Highlight any issues that the Panel/Committee has identified that may come to the attention of the Commissioners for resolution.

NONE

Proposed Meeting Dates and Draft Agendas:

Note the meeting schedule for the year and how the schedule of these meetings and the work in the intervening periods will lead to the completion of the assigned Tasks.

Attendance to meetings will be dependent on available resources.

January 2011 – PSC post season Meeting

- Review and discuss of preliminary post season 2010 fisheries information
- Collate and review report items for 2009 final post season report
- Initiate drafting of 2009 final report.
- Consider approaches and any technical requirements for implementing the 2008 revision of Annex IV, Chapter 6, Paragraph 10 of the PST.
- Continue work on Southern Chum genetic baseline inventory and expansion for adequately identifying stock origin of fish in mixed stock fisheries on both sides of the border.
- Review and discuss research and analysis activities, essential to the Committee tasks.
- Provide any bilateral analyses, as requested by the Southern Panel.

February 2011 – PSC Annual Meeting
(Committee note June 2012: the original Work Plan submission had 2010 for the year of this meeting by error)

- Address any specific tasks assigned to the Committee by the Southern Panel at the January meeting.
- Continue work on tasks not completed at the January meeting
- Assign workgroups and workgroup tasks for items still pending at the end of the February meeting.

Status of Technical or Annual Reports:

2008 Report was completed and submitted for publication in June 2010. The committee is in the process of working on the 2009 report with the anticipation of having it complete by the end of the February meetings in 2011.

Comments:

NONE